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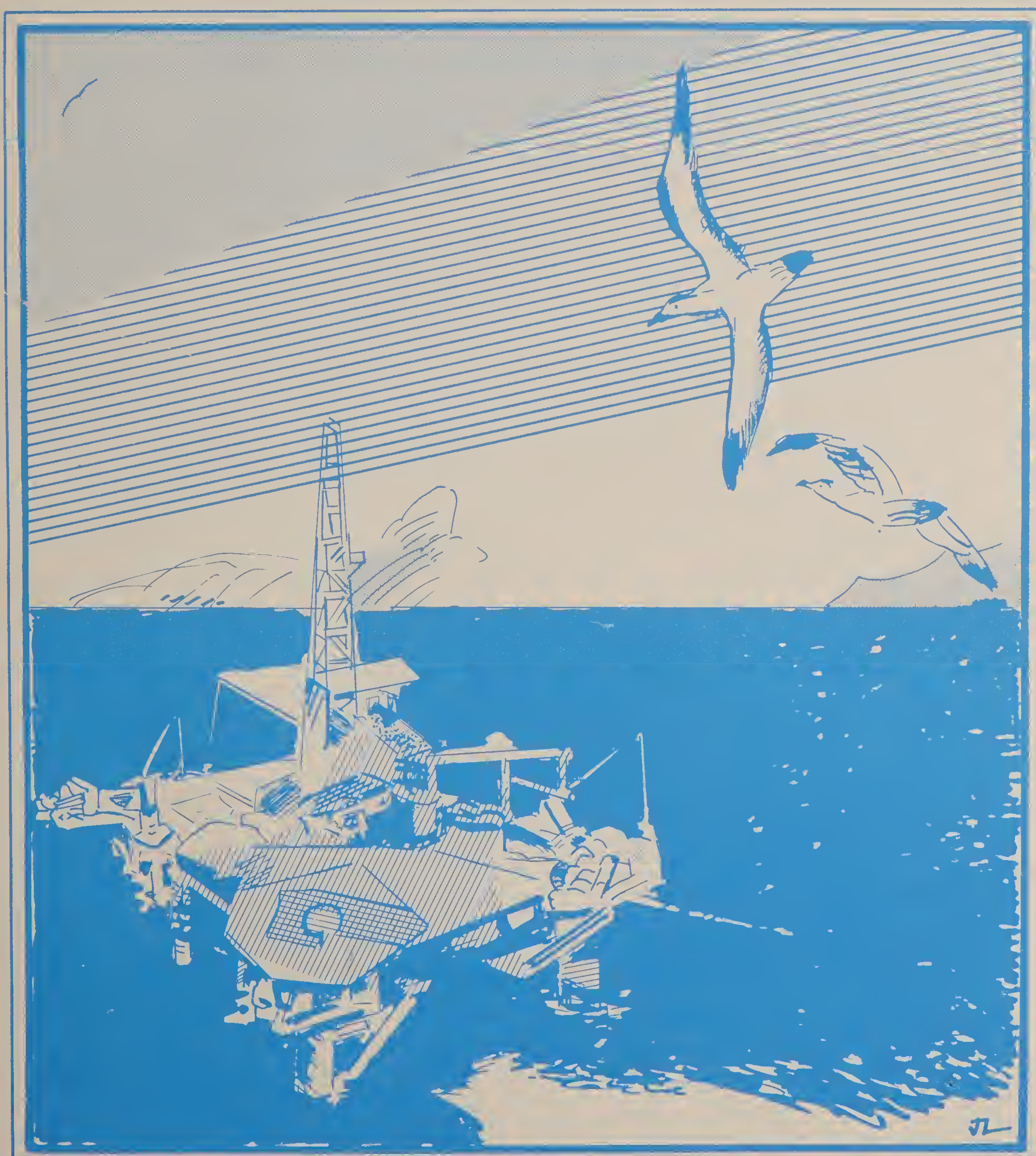
DRAFT
ENVIRONMENTAL IMPACT STATEMENT

**PROPOSED
1982 OUTER CONTINENTAL SHELF
OIL AND GAS LEASE SALE
OFFSHORE THE NORTH ATLANTIC STATES**

OCS SALE No.52



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UNITED STATES DEPARTMENT OF THE INTERIOR

DRAFT ENVIRONMENTAL IMPACT STATEMENT

PROPOSED 1982 OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE OFFSHORE THE NORTH ATLANTIC STATES

OCS SALE No. 52

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Cover Sheet

Draft Environmental Impact Statement
Proposed 1982 Outer Continental Shelf Oil and Gas Lease Sale No. 52

Lead Agency: U.S. Department of the Interior
Bureau of Land Management
New York Outer Continental Shelf Office

Abstract: The proposed action is the offering of 540 tracts (3.1 million acres; 1.2 million hectares) located from 86 to 164 statute miles offshore southeast Cape Cod and Nantucket Island, Massachusetts for leasing in accordance with the Outer Continental Shelf Lands Act, as amended. The tracts lie in average water depths of 171 to 9285 feet (52 to 2830 meters). If implemented, this sale is tentatively scheduled for October, 1982. Alternatives considered include a delay of the sale, cancelling the sale (no action), and five deletion options. The deletion options include: one to protect fisheries and other biological resources; one to protect resources located in canyon heads; one relating to deep-water concerns; one involving those tracts containing possible sediment slump; and one alternative that considers the Georges Bank as a Marine Sanctuary. All tracts studied pose some degree of risk to the environment. Mitigating measures, which may reduce the risk, have been identified.

Areas of Project Impact Onshore: Massachusetts, Rhode Island, New York, New Jersey and their coastal areas and Pennsylvania.

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Comments due: November 23, 1981

Draft Environmental Impact Statement
Proposed 1982 Outer Continental Shelf Oil and Gas Lease Sale No. 52
Offshore the North Atlantic States

SUMMARY

Description of Proposed Action

This proposal represents an effort to find new domestic sources of oil and gas and to obtain an increased degree of national energy independence.

The proposed action is the offering of a maximum of 540 blocks on the North Atlantic Outer Continental Shelf (OCS), Slope and rise for leasing, in accordance with the OCS Lands Act as amended, for the purpose of exploration, development and production of potential hydrocarbon resources. These blocks total 3,074,220 acres (1,229,688 hectares), lie in average water depths of 171 to 9,285 feet (52 to 2,830 meters) and range from 86 to 164 statute miles offshore southeast of Cape Cod and Nantucket Island, Massachusetts. The proposed Sale, tentatively scheduled for October 1982, would be the second OCS Oil and Gas Lease Sale in the North-Atlantic. There is no development or production in the region at this time. However, exploration is begun in the late summer of 1981 as a result of Sale No. 42.

Most of the proposed Sale area lies on the continental shelf and slope, seaward of those tracts previously leased in Sale No. 42. Under the deeper waters of the slope, there is an ancient buried reef that extends with gaps, from offshore Mexico through the Gulf of Mexico and along the Atlantic continental margin. This reef forms the seaward edge of the Baltimore Canyon Trough in the Mid-Atlantic and extends through the proposed Sale area. The nation's energy and security needs will be served by early testing and development of this area of potential hydrocarbon accumulation.

The U.S. Geological Survey has estimated that if the proposed sale area is hydrocarbon productive, it may contain from 0.017 to 6.35 billion barrels of oil and from 0.196 to 13.49 trillion cubic feet of gas. The conditional mean estimate of undiscovered recoverable resources is 1.73 billion barrels of oil and 5.25 trillion cubic feet of gas.

Issues and Areas of Concern

The scoping process shaped issue identification. The process included meetings with the public, and with federal and state officials, and analysis of written comments received in response to previous steps in the sale process. Scoping helped shape the alternatives and identify areas of controversy. The major areas of public concern identified include:

Conflicts due to increased vessel traffic.

Impacts of oil spills on recreation and tourism.

Oil spills and their impact on fisheries.

Debris on the bottom associated with OCS exploration, development and production activities.

Deep water technology.

Geohazards.

Protection of biological resources in canyons.

Offshore Oil Pollution Compensation Fund.

Oilspill cleanup capabilities.

The Proposed Action and Resulting Environmental Consequences

Alternative 1 is the proposed action. The main analysis in this Environmental Impact Statement (EIS) is based on the impacts that could occur if the conditional mean level of resources are produced and transported to shore by pipeline and tanker.

The actual decisions on transportation of oil and gas resources and locations of onshore facilities are not made at the stage of preparing an Environmental Impact Statement on a proposed lease sale. Such decisions would not actually be made until post-sale exploratory drilling had located economically recoverable reserves of a magnitude to justify the expense of producing the reserves and transporting them to shore. Hypothetical transportation and development scenarios are formulated in order to assess impacts.

All blocks in the proposed sale pose some degree of risk to the environment. Most potential impacts from drilling would be localized and temporary. Impacts on offshore air quality would be negligible as pollutants would be diffused rapidly in the offshore air mass. Onshore, due mainly to the distance of the Sale area and to the prevailing winds, the impacts on air quality would be negligible.

The U.S. Geological Survey estimates that the leasing of the 540 blocks in proposed Sale No. 52 may result in 10 oil spills greater than 1000 barrels over a thirty year period. The greatest risk would be from the transportation of the oil, not its production, because spills occurring in the proposed lease area have - except for those resources associated with the target identified as the Crest of the Bank - a relatively small chance of contacting nearshore or onshore vulnerable resources.

Most of the commercially important species of fish are caught on the continental shelf and along the shelf break near and within the proposed lease area. Results of the catch-loss model used to assess the space and use conflicts between the fishing and oil inductry indicate that proposed Sale No. 52 could result in a maximum of 2.0% of area lost in the groundfish otter trawl fishery, and lesser percentages in other fisheries. Although areas open to foreign fishing overlap the proposed lease area, little conflict is expected between OCS oil and gas activities and foreign fishing in the North Atlantic. Preliminary information from a BLM-sponsored study shows that timing of an oil spill is the most critical factor, especially if the spill occurs in conjunction with a poor-year class; such an event could have a major impact on that year-class and would be felt by the commercial fishing industry years after the spill occurred.

Of the endangered and threatened species found in the region, development activities of the proposed Sale may adversely impact the loggerhead, leatherback, and Atlantic ridley turtles during their migration period. A spill could pose a moderate threat to peregrine falcons migratory stopover areas. The impacts on endangered marine mammals are uncertain; but due to the relatively high number of expected spills (10), some adverse impacts may occur.

If the facilities resulting from this proposed sale were to be sited as assumed, some conflicts with land use plans and policies could occur. Assumptions include: two gas pipelines would have landfalls in Rhode Island; the gas would be processed in Massachusetts; the oil would be refined at existing Mid-Atlantic refineries and would be expected for the most part to replace foreign imports over the long-term.

Onshore development is not expected to result in any significant degradation of air and water quality due to sale-related facilities. Onshore resources that appear to be most vulnerable to risks from oil spills are those near the hypothetical and existing oil tankering routes.

The level of economic activity that is forecast may be absorbed on a regional basis without disruption, but possible employment and population changes induced by the proposed sale may result in increased demands for services and stresses to the physical and social infrastructure in some communities.

BLM's interpretation of preliminary data and information supplied by the USGS suggest that 94 blocks may show evidence of mass sediment movement. No shallow gas deposits were identified in the proposed sale area.

There are 8 stipulations proposed in the EIS as sale-specific mitigating measures concerning cultural resources; biological resources; transportation of oil and gas resources with pipeline and tanker transportation being considered; potential geologic hazards, the disposal of drill muds and cuttings; undetonated explosives; military areas; and a fisheries training program stipulation.

Other Alternatives

Alternative 2, Delaying the Sale, would not eliminate any potential impacts; it would merely delay their occurrence. No significant reason for delay has been identified. However, a beneficial effect of delaying the Sale would be the possibility that results from the Georges Bank Monitoring Program and some of the results of BLM-funded projects may be available for pre-Sale decisions.

Alternative 3, Cancelling the Sale or the No Action Alternative, would eliminate all impacts expected to result from the proposal, but not all impacts from OCS oil and gas activity in the region, as exploratory drilling from Sale No. 42 began during the summer of 1981. Also, the U.S. Geological Survey has estimated that tanker transportation of imported crude oil and refined petroleum products in the Mid- and North Atlantic could result in 93 oil spills greater than 1000 barrels over the next thirty years. To the extent that oil from proposed Sale No. 52 replaces imported oil, the risks associated with the proposed sale would be substituted for the risks associated with the transportation by tankers of oil imports.

Alternative 4 would delete 49 blocks in water depths greater than 2000 meters. The remaining blocks could be developed with existing technology. Impacts under this Alternative would be somewhat similar to those expected to occur under Alternative 1, the proposal. The incentive for industry to further develop deep water production technology would be lacking under this Alternative. The impact on the endangered sperm, and sei whales and the leatherback turtle would be reduced since these species spend much of their time in deep water.

Alternative 5 consists of a potential deletion of 205 blocks lying in water depths approximately 200 meters or less with the intention of minimizing any impacts on the fisheries of the region. Most environmental impacts would be less than those projected under Alternative 1, except that the adverse impact on commercial fisheries would be greatly diminished since relatively little domestic fishing activity takes place outside the proposed deletion area.

Alternative 6 would delete 33 blocks at the head of canyons because they are an important habitat for biological resources. Under this alternative, impacts to biological resources (e.g., corals) would be largely eliminated, impacts on pelagic birds might be less than under Alternative 1. Onshore impacts and impacts associated with transportation of resources would be similar under this alternative than to those impacts under Alternative 1.

Alternative 7 is a potential deletion of blocks in Georges Bank proper that are assumed to be integral to a possible Marine Sanctuary.
Impacts to coastal recreation and tourism will remain the same as those under Alternative 1. Impacts to threatened and endangered species under this Alternative would be similar to the impacts resulting if Alternative 5 is implemented. Marine turtles would benefit from designation of Nantucket Sound as a Marine Sanctuary. Impacts on commercial fisheries would be similar to those under Alternative 5. Reduction of impacts on air and water quality from those expected to occur if Alternative 1 is implemented would be insignificant.

Alternative 8 is a potential deletion of 94 blocks that, based on preliminary information, have been identified as possible sites of slumped sediments. Damage to OCS structures, blowouts, and associated oil spills are expected to be less likely under this alternative. A reduction of the amount of recoverable resources may be expected if this Alternative is implemented. Degree of impacts is, however, uncertain.

Cumulative Impacts

Activities which are likely to cause cumulative impacts with proposed Sale No. 52 are ocean dumping and other Atlantic OCS lease sales. In addition, activities in other areas which may impact migratory species using the lease sale area have been examined.

There are currently three leasing regions off the Atlantic coast. Certain migratory species could be more severely affected by drilling activities in all three Atlantic leasing areas. This potential for adverse impacts could be particularly severe for endangered species, such as the peregrine falcon, leatherback sea turtle and right whale.

For most resources, cumulative impacts with other OCS oil and gas lease sales would result from the activities associated with prior Mid- and North Atlantic sales. Cumulative impacts on most offshore resources would be greater than those expected as a result of proposed Sale No. 52 alone. This is due to the relatively large resource estimates projected for proposed Sale No. 59, the Mid-Atlantic. Although resource estimate for Sales No. 40, 42, and 49 are low, the combined results from these Sales is expected to generate a great degree of activity to explore, develop, and produce offshore the Mid- and North Atlantic region.

Commercial fishermen may be excluded from more area in the North Atlantic, as the area around the projected rigs and pipeline for resources from Sale 42 would be added to that around the two pipelines and rigs projected for proposed Sale No. 52.

Fishing activities in the Mid- or South Atlantic regions would not be affected by oil and gas activity in the North Atlantic.

The projected number of oil spills greater than 1000 barrels as a result of proposed Sale No. 52 is approximately 10. If the resource estimates of the proposed Sale are taken together with those for Sale No. 42, the projected number of spills greater than 1000 barrels is 11. The number of spills from Sales Nos. 40, 49, and proposed Sale No. 59 is expected to be approximately 13. Although the resource estimates for the Mid- and North Atlantic should not be lumped together when estimating the number of oil spills expected to result from all the sales combined, the higher resource estimates associated with the proposed Sales No. 52 and 59 areas result in an increased risk of an oilspill in the cumulative case.

If oil from another Atlantic OCS area were to be transported by tanker to the Mid-Atlantic for refining, impacts from this would probably be similar to those impacts of imported oil and refined products transported by tanker already occurring in the region. The U.S. Geological Survey has estimated that tanker transportation of imported crude oil and refined petroleum products in the Mid- and North Atlantic could result in 93 oil spills greater than 1000 barrels over the next thirty years. To the extent that OCS oil replaces imported oil, the risks associated with OCS oil would be substituted for the risks associated with the transportation of oil imports.

Additional onshore facilities in the Mid-Atlantic could add to potential impacts in New Jersey. Cumulative economic impacts would occur in and near Washington County, Rhode Island, from Sales 40, 49 (Mid-Atlantic), 42 (North Atlantic) and proposed Sales No. 59, and 52 due to the supply base in Davisville which will be used for both North and Mid-Atlantic operations support.

TABLE OF CONTENT

Section 1

Purpose of And Need For Action

I. Purpose of and Need for Action

A. Description and Background of the Proposal

1. Location and Resources

The proposed federal action is the offering for lease in October, 1982, of 540 tracts on the North Atlantic Outer Continental Shelf (OCS) region, in an area known as the Georges Bank, for the purpose of exploration, development, and production of potential hydrocarbon resources. This proposal is an integral part of the effort to find new domestic sources of oil and gas and to obtain an increased degree of national energy independence.

Proposed Sale No. 52 would be the second lease sale in the North Atlantic region. The first OCS lease sale in this region, Sale No. 42, was held in December, 1979. Of the original 206 tracts, seventy-eight (78) were withdrawn: 28 on December 7, 1976; 12 on October 11, 1977; 11 on December 23, 1977; and 27 on January 28, 1978. An additional 12 tracts at the head of Lydonia Canyon were withdrawn on September 21, 1979. Reasons for these deletions included proximity to shore, conflict with fishing-vessel traffic, and biological considerations (corals, lobsters, and fish populations at the head of Lydonia Canyon). None of these tracts are included in the proposed Sale No. 52. There are currently 63 active leases in the region. Although no drilling has taken place as a result of the first sale, some exploratory activity began during late summer of this year, 1981.

Each tract consists of 5693 acres (2304 hectares) or approximately nine square miles. The 540 tracts being considered total 3.1 million acres (1.2 million hectares), lie in average water depths of 171 to 9285 feet (52 to 2830 meters) and range from 86 to 164 statute miles offshore southeast Cape Cod and Nantucket Island, Massachusetts. The area under study in this EIS (Sale No. 52 area) is shown in Figure I.A.1-1. Also shown in this Figure are existing leased tracts in the North Atlantic and existing and proposed leases in the Mid-Atlantic.

In accordance with the Final Five-Year OCS Oil and Gas Leasing Schedule (Figure I.A.1-2) signed by the Secretary of the Interior in June, 1980, proposed Sale No. 52 in the North Atlantic is tentatively scheduled for October, 1982. The Five-Year Schedule also shows another North Atlantic sale, proposed Sale No. 82, tentatively scheduled for October, 1984.

The development of the lease schedule and the national implications of all OCS oil and gas lease sales are discussed in the Final Environmental Statement (FES) on the Five-Year Schedule published in January, 1980. A draft supplement to this FES was published in June, 1981. It addresses a new proposal to accelerate leasing in all OCS areas, including the North and Mid-Atlantic regions. This new schedule should be implemented early in January, 1982.

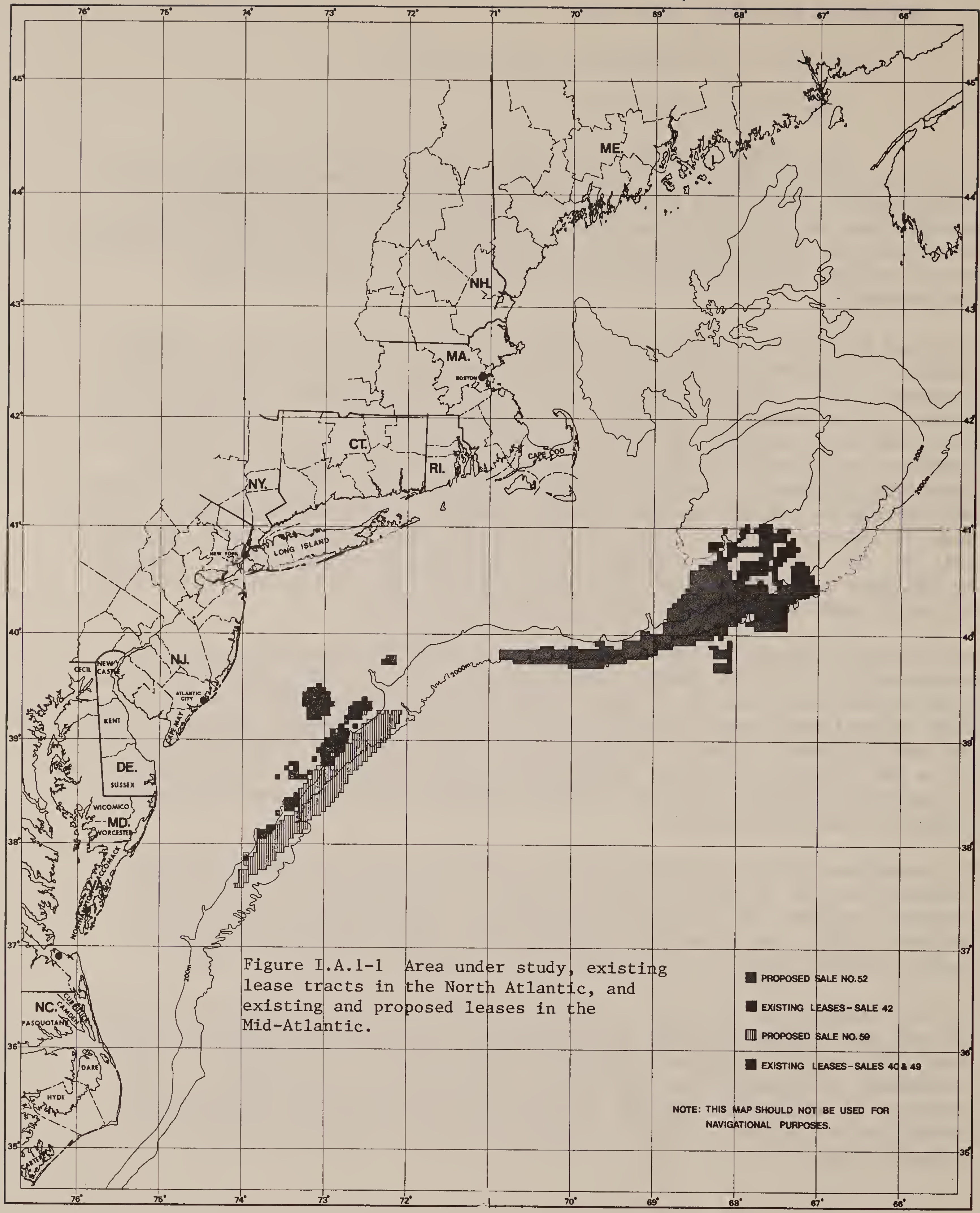

Figure I.A.1-1 Area under study, existing lease tracts in the North Atlantic, and existing and proposed leases in the Mid-Atlantic.

Figure I.A.1-2

FINAL 5-YEAR OCS OIL & GAS LEASING SCHEDULE

JUNE 1980

Proposed sale areas and proposed dates:

PROPOSED SALE AREA	PROPOSED DATE
A62 Gulf of Mexico	9/80
55 Gulf of Alaska	10/80
62 Gulf of Mexico	11/80
53 Central N. Calif.	5/81
RS-1 Reoffering Sale	6/81
A66 Gulf of Mexico	7/81
56 South Atlantic	8/81
60 Cook Inlet	9/81
66 Gulf of Mexico	10/81
59 Mid-Atlantic	12/81
67 Gulf of Mexico	3/82
RS-2 Reoffering Sale	6/82
68 Southern California	6/82
69 Gulf of Mexico	8/82
57 Norton Basin	9/82
52 North Atlantic	10/82
70 St. George Basin	12/82
71 Beaufort Sea	2/83
72 Gulf of Mexico	3/83
61 Kodiak	4/83
73 California	5/83
RS-3 Reoffering Sale	6/83
74 Gulf of Mexico	9/83
75 No. Aleutian Shelf	10/83
76 Mid-Atlantic	11/83
78 South Atlantic	1/84
79 Gulf of Mexico	3/84
RS-4 Reoffering Sale	5/84
80 California	6/84
81 Gulf of Mexico	7/84
82 North Atlantic	10/84
83 Navarin Basin	12/84
84 Gulf of Mexico	1/85
☆85 Chukchi Sea	2/85
86 Hope Basin	5/85
RS-5 Reoffering Sale	6/85

1980

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
A62 Gulf of Mexico	9/80		F			P	S_c	R	N	S			
55 Gulf of Alaska	10/80			F		P		S_c	R	N	S		
62 Gulf of Mexico	11/80		F				P		S_c	R	N	S	
53 Central N. Calif.	5/81				E		H			F	P		
A66 Gulf of Mexico	7/81							E		H			F
56 South Atlantic	8/81							E		H			
60 Cook Inlet	9/81								E		H		
66 Gulf of Mexico	10/81							E		H			F
59 Mid-Atlantic	12/81											E	
67 Gulf of Mexico	3/82	C		D		T							
68 Southern California	6/82		D			T							
69 Gulf of Mexico	8/82	C		D		T							
57 Norton Basin	9/82		T										
52 North Atlantic	10/82		D				T						
70 St. George Basin	12/82		T										
71 Beaufort Sea	2/83			T									
61 Kodiak	4/83									C		D	
73 California	5/83											C	
75 No. Aleutian Shelf	10/83					C			D				T

1981

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
53 Central N. Calif.	5/81		S_c	R	N	S							
RS-1 Reoffering Sale	6/81	P		S_c	R	N	S						
A66 Gulf of Mexico	7/81		P		S_c	R	N	S					
56 South Atlantic	8/81	F		P		S_c	R	N	S				
60 Cook Inlet	9/81		F		P		S_c	R	N	S			
66 Gulf of Mexico	10/81					P		S_c	R	N	S		
59 Mid-Atlantic	12/81	H				F		P		S_c	R	N	S
67 Gulf of Mexico	3/82			E		H			F		P		S_c
68 Southern California	6/82					E		H				F	
69 Gulf of Mexico	8/82			E		H			F				
57 Norton Basin	9/82						E				H		
52 North Atlantic	10/82									E		H	
70 St. George Basin	12/82										E		
71 Beaufort Sea	2/83												E
72 Gulf of Mexico	3/83	C		D		T							
61 Kodiak	4/83		T										
73 California	5/83	D			T								
74 Gulf of Mexico	9/83	C		D		T							
76 Mid-Atlantic	11/83					C		D			T		
78 South Atlantic	1/84			C			D				T		
80 California	6/84										C		D
83 Navarin Basin	12/84						C			D			
☆85 Chukchi Sea	2/85							C			D		
86 Hope Basin	5/85									C			D

1982

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
67 Gulf of Mexico	3/82	R	N	S									
RS-2 Reoffering Sale	6/82		P		S_c R	N	S						
68 Southern California	6/82	P		S_c	R	N	S						
69 Gulf of Mexico	8/82			P		S_c	R	N	S				
57 Norton Basin	9/82		F		P		S_c	R	N	S			
52 North Atlantic	10/82			F		P		S_c	R	N	S		
70 St. George Basin	12/82	H				F		P		S_c	R	N	S
71 Beaufort Sea	2/83			H				F		P		S_c	R
72 Gulf of Mexico	3/83			E		H			F		P		S_c
61 Kodiak	4/83			E			H			F		P	
73 California	5/83				E		H				F		P
74 Gulf of Mexico	9/83			E		H			F				
75 No. Aleutian Shelf	10/83								E			H	
76 Mid-Atlantic	11/83										E		H
78 South Atlantic	1/84											E	
79 Gulf of Mexico	3/84	C		D		T							
80 California	6/84			T									
81 Gulf of Mexico	7/84	C		D		T							
82 North Atlantic	10/84				C		D			T			
83 Navarin Basin	12/84	T											
84 Gulf of Mexico	1/85											C	
☆85 Chukchi Sea	2/85		T										
86 Hope Basin	5/85				T								

1983

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
71 Beaufort Sea	2/83	N	S										
72 Gulf of Mexico	3/83	R	N	S									
61 Kodiak	4/83	S_c	R	N	S								
73 California	5/83		S_c	R	N	S							
RS-3 Reoffering Sale	6/83		P		S_c R	N	S						
74 Gulf of Mexico	9/83				P		S_c	R	N	S			
75 No. Aleutian Shelf	10/83			F		P		S_c	R	N	S		
76 Mid-Atlantic	11/83				F		P		S_c	R	N	S	
78 South Atlantic	1/84		H				F		P		S_c	R	N
79 Gulf of Mexico	3/84			E		H			F		P		S_c
80 California	6/84					E		H				F	
81 Gulf of Mexico	7/84			E		H			F				
82 North Atlantic	10/84									E		H	
83 Navarin Basin	12/84										E		
84 Gulf of Mexico	1/85	D		T									
☆85 Chukchi Sea	2/85												E

1984

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
78 South Atlantic	1/84	S											
79 Gulf of Mexico	3/84	R	N	S									
RS-4 Reoffering Sale	5/84	P		S_c R	N	S							
80 California	6/84	P		S_c	R	N	S						
81 Gulf of Mexico	7/84		P		S_c	R	N	S					
82 North Atlantic	10/84			F		P		S_c	R	N	S		
83 Navarin Basin	12/84	H				F		P		S_c	R	N	S
84 Gulf of Mexico	1/85	E		H			F		P		S_c	R	N
☆85 Chukchi Sea	2/85			H				F		P		S_c	R
86 Hope Basin	5/85			E			H				F		P

1985

PROPOSED SALE AREA	PROPOSED DATE	J	F	M	A	M	J	J	A	S	O	N	D
84 Gulf of Mexico	1/85	S											
☆85 Chukchi Sea	2/85	N	S										
86 Hope Basin	5/85		S_c	R	N	S							
RS-5 Reoffering Sale	6/85		P		S_c R	N	S						

Secretary of the Interior

C - Call For Nominations
D - Nominations Due
T - Tentative Tract Selection
E - Draft Environmental Statement
H - Public Hearing
F - Final Environmental Statement
P - Proposed Notice of Sale
S_c - State Comments Due
R - Energy Review
N - Notice of Sale
S - Sale

☆The holding of the Chukchi Sale at this time is contingent upon a reasonable assumption that technology will be available for exploration and development of the tracts included in the sale.

Most of the proposed sale area lies on the continental shelf and slope seaward of the tracts currently leased in the region. Under the deeper waters of the slope, an ancient buried reef runs with gaps, from offshore Mexico through the Gulf of Mexico and along the Atlantic continental margin. This reef forms the seaward edge of the Baltimore Canyon Trough in the Mid-Atlantic and continues through the proposed sale area. The nation's energy and security needs will be served by early testing and development of this area of potential hydrocarbon accumulation.

Table I.A.1-1 gives the U.S. Geological Survey's estimates for oil and gas potential in the proposed sale area.

Table I.A.1-1

Estimated Undiscovered Recoverable Oil and Gas Resources

Proposed Sale No. 52	Conditional Oil (Billion Barrels)	Gas (Trillion Cu. Ft.)
LOW	0.017	0.196
MEAN	1.73	5.25
HIGH	6.35	13.49

Source: USGS, 1980

2. Administrative Steps Leading up to the Proposal

The preparatory stages leading up to the proposed Sale No. 52 take almost three years.

Resource Reports: The request for resource reports, sent to all intended Federal agencies with activities and expertise appropriate to the proposed area, is the first step in the tract identification process. The Bureau of Land Management's (BLM) New York Outer Continental Shelf (OCS) Office requested resource reports for proposed Sale No. 52 in July 1979.

Call for Nominations and Comments: The Department of the Interior issued a Call for Nominations and Comments in December, 1978. However, on March 19, 1979 the Secretary announced that Interior would take no further action on proposed Sale No. 52, pending development of a new Five-Year Leasing Schedule. A new Call for Nominations and Comments later appeared in the Federal Register on December 31, 1979.

The call area consisted of 2,981 blocks covering approximately 17 million acres (6.9 million hectares), lying from 15 to 170 statute miles offshore, in water depths ranging from approximately 66 to 8530 feet (20 to 2600 meters). The current schedule, Figure I.A.1-2, shows the tentative sale planned for October 1982.

Nominations were received from 10 companies for a total of 1261 blocks containing about 7.2 million acres (2.9 million hectares). Forty comments of concern were also received from state, local, and federal agencies, conservation, environmental and fishing groups, and many private individuals on areas they think should not be leased or leased with restrictions on drilling.

The Manager's Environmental Briefing for proposed Sale No. 52 was held in New York City on April 16, 1980 in conjunction with a meeting of the Intergovernmental Planning Program's (IPP) North Atlantic Technical Working group. Presentations on tract nominations and environmental issues were given. The meeting of this Technical Working Group on April 17, 1980 also included discussion of tract selection.

Tentative Tract Selection: All tract nominations, comments of concern, environmental issues raised, and Technical Working Group recommendations concerning tract selection were evaluated to arrive at the joint recommendation of BLM and USGS for tentative tract selection.

The announcement that 540 tracts were tentatively selected for environmental study for proposed Sale No. 52 was made on July 1, 1980. Although these tracts are intermingled with the 63 tracts leased from Sale No. 42, the majority lie in a band that sweeps south and west of the Sale No. 42 tracts.

Secretarial Issue Document (SID): Subsequent to the publication of the Final EIS, the New York OCS Office will prepare a SID which outlines environmental and physical factors and other issues, including potential economic and social impacts of the proposal. The SID is used by the Secretary in making his decision on whether to hold the sale, whether to choose alternatives proposed, and what tracts and stipulations to include.

Notice of Sale: If the Secretary's preliminary decision is to proceed with this sale, a Proposed Notice of Sale will be issued in May, 1982, indicating the tracts proposed for leasing, the stipulations to be made part of the leases, bidding systems proposed to be used, and any pertinent information to lessees deemed necessary for potential bidders. Governors of affected states are allowed up to 60 days to comment on the proposed lease sale. The Secretary is required to consider the Governors' comments regarding the size, timing, and location of the proposed lease sale, and he must indicate in writing his reasons for accepting or rejecting their recommendations. At least 30 days prior to the scheduled sale, a final Notice of Sale is published in the Federal Register.

Under certain conditions, the Secretary has the option of offering larger leasing units than the historical maximum of 5,760 acres or longer lease terms than the traditional 5 years. Considerations such as the deep water aspect of this sale may warrant the adoption of one or both of these options.

Environmental Impact Statement (EIS): The New York OCS Office is responsible for preparing the EIS. The Notice of Intent to prepare an EIS appeared in the November 13, 1980 Federal Register.

After the Draft Environmental Impact Statement (DEIS) is published in September, 1981, a public hearing will be held in November, 1981. All oral and written comments received will be evaluated and revisions incorporated into the Final Environmental Statement to be published in March, 1982.

Endangered Species Consultation: Pursuant to Section 7 of the Endangered Species Act, formal consultation must take place between BLM, the Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS). This process was initiated by the letters which appear in Appendix F. A formal consultation meeting was held in the New York OCS Office on April 22, 1981. FWS and NMFS are required to provide BLM with a formal biological opinion within 90 days of the date on which consultation was initiated. The FWS opinion appears in Appendix F.

Sale: The New York OCS Office will conduct the lease sale, determine the highest qualified bidder for tracts, and forward its recommendations on the acceptance of bids for approval by the Secretary and review by the Attorney General. Once approval has been given, the New York OCS Office will ensure that successful bidders have posted the proper bond and issue the leases.

3. Results of the Scoping Process

The scoping process included meetings with the public, and with federal and state officials, and analysis of written comments received in response to the Request for Resource Reports, the Call for Nominations and comments, tract selection recommendations, and the Notice of Intent, as well as staff members' experience with identifying significant issues in the previous North-Atlantic Environmental Impact Statement.

A detailed scoping report is included in Appendix B. The scoping process helped shape the alternatives and identify significant issues to be analyzed in the EIS. A summary of the major areas of concern raised through scoping, and the sections of this EIS which address them follow:

Impacts on commercial fisheries ((IV.C.7, II.B.5)
Deep-water technology (Appendix G, II.B.4)
Remove tracts deleted in Sale No. 42 (II.B.1)
Delay Sale No. 52 until results from Sale No. 42 are available (II.B.2)

Mobile Bedforms: geohazards, slumping (IV.B.1)
Delete tracts closer than 50 miles from shore (II.B.1)
Conflict with shipping lanes, vessel traffic (IV.C.7, IV.C.8)
Debris on the bottom and its impact on fisheries (IV.C.7, IV.A.1)
Fishermen's Contingency Fund (I.B.1.c.)
The effects of drilling muds and cuttings (IV.C.3, IV.C.7)
Georges Bank Gyre and oilspill entrainment (IV.C.7)

4. BLM Environmental Studies Program

The following Table I.A.4 lists the funded studies for the North Atlantic and indicates sections of the Environmental Impact Statement where results have been utilized.

Table I.A.4. North Atlantic Environmental Studies
Issues Addressed by Each Study*

Title	Commercial Fishing/ Shipping Conflicts	Recreation	Social Conflicts	Marine and Coastal Ecosystems	Air and Water Quality	Cultural Resources	Natural Hazards	Ports and Harbor Conflicts	Results Utilized From the Studies
A Socio-Economic and Environmental Inventory of the North Atlantic Region from Sandy Hook, N.J. to the Bay of Fundy (Literature Survey, 1974)	X	X	X	X	X	X	X		III.B.1.a III.B.1.b
A Summary of Environmental Information on the Continental Slope from the Canadian/United States Border to Cape Hatteras, N.C. (Literature review, 1976)	X			X	X	X	X		III.A.1
New England Outer Continental Shelf Physical Oceanography (Two Years, 1980)				X	X		X		III.A.3 III.B.1.a IV.C.3 IV.C.4
Geological Studies of the North Atlantic				X	X		X		III.A.1 IV.B.2
A Summary of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras (Literature Survey, 1977)	X			X	X	X	X		III.B.2.C IV.B.2

Issues Addressed by Each Study

Title	Commercial Fishing/ Shipping Conflicts	Recreation	Social Conflicts	Marine and Coastal Ecosystems	Air and Water Quality	Cultural Resources	Natural Hazards	Ports and Harbor Conflicts	Results Utilized From the Studies
Marine Mammal and Marine Turtle Characterization in the North and Mid-Atlantic				X					III.B.1.d IV.C.6
A Climatological and Oceanographic Analysis of the Georges Bank Region of the Outer Continental Shelf				X	X				III.A.2
Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras (1979)						X			III.C.6
Canyon Assessment Study in the North and Mid-Atlantic (1980)	X			X	X				III.B.1.b
Study of the Economic Costs from Oil Spills to Commercial Fishing	X	X	X	X					IV.C.3

Issues Addressed by Each Study

Title	Commercial Fishing/ Shipping Conflicts	Recreation	Social Conflicts	Marine and Coastal Ecosystems	Air and Water Quality	Cultural Resources	Natural Hazards	Ports and Harbor Conflicts	Results Utilized From the Studies
Study of Physical and Biological Processes of Canyons and the Continental Slope in the North and Mid-Atlantic Outer Continental Shelf	X			X	X		X		II.B.6 IV.C.4
An Assessment of Space and Use Conflicts on the U.S. Outer Continental Shelf Between the Oil and Gas Industry and Commercial and Recreational Fishermen	X	X	X	X			X		IV.C.8 IV.C.9
Study of Effects of Oil on Marine Mammals				X	X				IV.C.6
The Effects of Sound on Marine Mammals				X	X				IV.C.6

* Categories as defined in the North and Mid-Atlantic Regional Study Plans.

B. Relationship with Other Projects and Proposals

1. Coastal Zone Management Program

The Coastal Zone Management (CZM) Act of 1972, as amended, administered by the Office of Coastal Zone Management (OCZM), National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, provides grants-in-aid to States for the development and implementation of management programs to control land and water uses in the coastal zone. In order to qualify for implementation funds, a State must develop its management program within four years from its initial participation. The Act established a mechanism to balance the protection of the coastal environment with development and economic interests.

Section 307 of the Act provides for consistency of Federal programs with approved State plans. Under the consistency provision of the Act, exploration plans and development and production plans of OCS oil and gas leases are specifically indicated as items which must receive consistency review by affected coastal States with approved management plans. In addition, any pre-leasing activities which the Secretary determines "directly affect" the coastal zone require a consistency determination.

Section 308 of the Act established a ten year Coastal Energy Impact Program (CEIP) to offset impacts from offshore oil and gas development, providing up-front grants, loans, and other funds for the planning, preparation, and mitigation of OCS-related onshore impacts. This program has funded projects in each of the 7 states in the North-Atlantic region.

Under the proposed FY 82 budget, all Section 308 funding to the states (with the exception of $27 million in formula grants) will be terminated. Section 306 development and approval grants are also scheduled to end as of 30 September 1981. While the effects of these cuts on the continuation of state coastal zone management efforts cannot be accurately determined at this time, it can be assumed that some states will have to significantly cut back their ongoing programs. Some programs may be terminated unless the state provides its own funding.

Of the states that could influence OCS oil and gas development in the North Atlantic region through their CZM programs, Maine, Massachusetts, Rhode Island, Connecticut, and New Jersey have approved programs, and have begun to use the legal authorities available to them through the CZMA. A brief summary of each of these programs and their key policies dealing with OCS activities follows.

Maine's coastal zone management policies are generally supportive of OCS development on Georges Bank due to the positive stimulus that such development would have on certain sectors of the New England and Maine economies. Maine wants assurances that OCS development of Georges Bank will take place with maximum safeguards for the environment and other resources of the area, including fish stocks and breeding areas.

Maine will seek these safequards through applying the consistency criterion embodied within its approved CZM Plan. The State has examined the five exploration plans filed for Sale No. 42, and has granted consistency certifications for these provided that the operators ensure that 1) additional monitoring of the discharges of drill muds and cuttings take place, and 2) that each oil company conduct a drill as part of its oil spill contingency planning.

OCS development is generally encouraged by the Commonwealth of Massachusetts as a possible means of providing resources of oil and gas to New England. The Massachusetts CZM Program will allow this development if special care is exercised to avoid harm to the resources of the coast that already provide benefit to man. The most important of these are the fishery resources of coastal waters (including known spawning areas and traditional fishing grounds); the quality of coastal waters which serves to maintain the health and harvestability of coastal fisheries; wildlife wintering, nesting, and migratory stop-over areas; and the recreation resources of the coast, particularly the bathing beaches. The Commonwealth will also review federal leasing activities, OCS exploration, development and production plans, applications for pipeline rights-of-way, and any federally licensed energy facility related to OCS development for consistency with the State program. The opportunity for such review is provided by Section 307(c) of the Coastal Zone Management Act as amended in 1978. Massachusetts has completed its review of four of the five Sale No. 42 exploration plans submitted, and on 16 June 1981 issued a consistency certification for each of these. The fifth plan is still being reviewed, and a decision on this is expected during the summer of 1981.

The Rhode Island program encourages the development of OCS oil and gas resources provided that certain policies discussed in the approved program, and elaborated upon in the State Energy Amendments, are adhered to. These policies regulate the siting, construction, alteration and/or operation of petroleum processing, transfer, or storage facilities and power generating facilities within the State which require a permit from the Coastal Management Council. An application for one of these facilities must provide reliable and probative evidence that the proposal will not: 1) conflict with any Council plan or program; 2) make any area unsuitable for any use or activity to which it is allocated by a resources management plan or program; or 3) significantly damage the environment of the coastal region. The program document includes a section on the development of a facilities plan for the Davisville-Quonset Point Area, which is currently being used as a support base for Mid-Atlantic OCS operations.

Rhode Island has completed its review of the five U.S. Geological Survey approved exploration plans filed in the North Atlantic, and has concurred with each of them.

The State of Connecticut recognizes the importance of OCS development in the Georges Bank and has stated that these resources should be "developed in an orderly manner consistent with national energy and environmental policies". To date, Connecticut has concurred in the consistency certifications for four of the five Sale No. 42 exploration plans. Five constraints will ultimately affect the siting of major OCS-related facilities in Connecticut's coastal area:

(1) The large distance separating Connecticut from the major areas of OCS activity and the availability of suitable alternative sites closer to major lease areas;

(2) The lack of suitable vacant tracts of land;

(3) Insufficient deepwater access to the coast for tankers;

(4) Transshipment problems posed by the narrow entrance channels to Long Island Sound and the existing large volumes of commercial and recreational boat traffic.

(5) Air pollution which could result from gas plant or refinery construction.

The State however, may experience some indirect impacts of OCS development due to increased production in the industrial sector. Ancillary industries, such as tool and machinery manufacturing, diving services and other support oriented businesses could be attracted to the State as a result of the proposed Sale.

New Jersey's program generally encourages OCS development as long as all related onshore activities do not conflict with existing land uses and are conducted in accordance with the policies of the program. Onshore activities for the development and production of offshore hydrocarbons must be carried out according to specific energy facility policies which relate to the need for and acceptability of all proposed new or expanded coastal energy facilities. The program states that while pipelines, pumping and compressor stations would be permitted within most coastal areas, oil and gas facilities should ideally be located outside these coastal locations on sites such as those adjacent to Raritan Bay.

The Department of the Interior determined that with respect to the leases issued for Sale No. 42, New Jersey was not "directly affected", and thus not eligible for rendering concurrence with any of the exploration plans filed as a result of this sale. This determination was only applicable to Sale No. 42 and, depending upon the location of the tracts leased for proposed Sale No. 52, New Jersey may become involved in making consistency determination for this and future North Atlantic sales.

New Hampshire's continued participation in the Federal Coastal Zone Management Program is uncertain. On May 19, 1981, legislation required to meet the objectives of the Coastal Zone Management Act was defeated by the New Hampshire State legislature. Passage of this legislation was needed prior to the preparation of a draft program document. It is possible however, that the State may revise and re-introduce this legislation at some future date.

Approval of New York State's Coastal Zone Management Program hinges on the passage of key program legislation by the State Senate and Assembly. This is scheduled to be brought to Committee in the Assembly during the current session. Federal funding for New York's Coastal Zone Management program was terminated in January 1981 when OCZM declared the State ineligible for further funds due to previous Senate delays in passing legislation required for program development. The State is currently using its own resources in order to complete its program.

2. Estuarine Sanctuaries

The estuarine sanctuaries program is authorized under Section 315 of the Coastal Zone Management Act and administered under federal regulations 15 CFR 921. The program provides grants to states on a matching basis to develop areas as estuarine sanctuaries. The Office of Coastal Zone Management under NOAA is responsible for implementing the program. The purpose of the sanctuaries program is to provide natural field laboratories in which to study the natural and human processes occurring within the estuaries of the coastal zone. Multiple use of estuarine sanctuaries will be allowed to the extent that such use is compatible with the primary purpose of the sanctuary. Non-compatible uses, including those uses which would cause significant short or long-term ecological change or would otherwise detract from or restrict the use of the sanctuary, will be prohibited.

The only designated estuarine sanctuary in the North Atlantic region is located in Narragansett Bay, Rhode Island (see Visual No. 2). This sanctuary includes Hope Island, Patience Island, the northern end of Prudence Island, and their surrounding waters for a total of 2,629 acres. OCS oil and gas related activities are not expected to interfere with the existing sanctuary uses due to its upstream location from the OCS support base at Davisville, Rhode Island, and relatively safe distance from oil drilling and transportation operations. In addition, the Office of Coastal Zone Management has published a draft environmental impact statement on a proposed estuarine sanctuary on the Mullica River in the Great Bay area along the coast of New Jersey (May, 1981).

The State of Maine plans to propose a multiple-site estuarine sanctuary comprised of three sites. These would be located at Machias Bay, Washington County; Sheepscot Bay, Lincoln County; and a marsh behind Drake Island near Wells in York County. The acquisition grant would be requested by September 30, 1981. The State of New Hampshire is planning to propose the southern Great Bay area as an estuarine sanctuary. This is west of Portsmouth. The proposal, if approved, would be scheduled for an acquisition grant award in 1982. Oil and gas exploration and development activities in the North Atlantic region are not expected to occur in the vicinity of any proposed estuarine sanctuaries.

3. Marine Sanctuaries

Title III of the Marine Protection, Research and Sanctuaries Act of 1972 authorizes the Secretary of Commerce, with presidental approval, to designate ocean waters as marine sanctuaries for the purpose of preserving or restoring their conservation, recreational, ecological or aesthetic values. NOAAA administers the program through its Office of Coastal Zone Management.

Presently, there are no active candidates for Marine Sanctuaries in the North Atlantic. The Georges Bank nomination remains on the List of Recommended Areas (LRA). Under the terms of the settlement agreement for the litigation pertaining to Lease Sale No. 42 (Conservation Law Foundation v. Andrus, 13, ERC 1865), NOAA is required to evaluate available information on Georges Bank by December 1, 1981 to determine whether all or parts of the area should be placed on the List of Active Candidates.

The recommendation to designate the central area of Nantucket Sound as a marine sanctuary was received on December 28, 1980 by NOAA from the Governor of Massachusetts, Edward J. King, to provide a mechanism to protect the resources as well as the bilogoical and recreational integrity of the entire Nantucket Sound region. It has been submitted in accordance with a settlement agreement in United States v. Maine, et. al. (Massachusetts); a case litigating the boundaries and jurisdiction of the Commonwealth of Massachusetts and the United States. NOAA has reviewed this recommendation in accordance with the site evaluation criteria (15 CFR 922.21(b)) and found it met the requirements for placement on the LRA. The LRA contains a list of areas that have at least some potential for being designated as a marine sanctuary. However, placement on the LRA is a preliminary step only and does not assure that a designation will occur. After consultation with interested persons and State and local officials, NOAA will decide whether to declare the site an alternative national marine sanctuary arrangements for the Central Area of Nantucket Sound, including alternative boundaries and management regimes.

An area nominated for sanctuary status must have one or more of the following resource values to be eligible for placement on the list of recommended areas: 1) a marine ecosystem characterized by the significant presence of one or more species which (i) is rare, endangered or threatened, (ii) has limited geographical distribution, or (iii) is rare in the waters to which the Act applies; 2) a marine ecosystem of exceptional richness indicated by the abundance and of marine species and the productivity of the various trophic levels in the food web; 3) an important habitat during one or more stages in the life cycle of species described in paragraph (1) or habitat on which one or more commercially

or recreationally valuable marine species depends for one or more stages in its life cycle (life cycle activities include breeding, feeding and rearing young); 4) Intensive recreational use growing out of its distinctive marine characteristics; 5) Historic or cultural remains of widespread public interest; and 6) Distinctive or fragile geological features of exceptional scientific or educational value.

The procedures and the criteria for review of sanctuary sites are described in the revised Marine Sanctuary Regulations (44 Federal Register 44831, July 31, 1979).

With the exception of the Boston Harbor area, the state marine waters bordering Massachusetts have been divided into five contiguous ocean sanctuaries. From North to South, the official sanctuary names include the North Shore, South Essex, Cape Cod Bay, Cape Cod, and the Cape and Islands Ocean Sanctuaries. The Massachusetts Department of Environmental Management is responsible for exercising the "care and control" of the ocean sanctuaries and shall act as a trustee of sanctuary resources. In that role as trustee the Department shall ensure that the ocean sanctuaries shall be protected from any exploitation, development, or activity that would seriously alter or otherwise endanger the ecology or the appearance of the ocean, the seabed, or subsoil therof, or the Cape Cod National Seashore.

4. Fishery Conservation and Management Act of 1976 (FCMA)

The Fishery Conservation and Management Act (FCMA), enacted in 1976, provides a method to manage and conserve the fishery resources of the U.S. The Fishery Conservation Zone (FCZ) extends 200 miles from the coast. All commercial species of finfish and shellfish within the FCZ are under the exclusive fishing management authority of the U.S. except for highly migratory species such as tuna. For Georges Bank, the regulatory mechanisms required by FCMA are managed by the New England Regional Fishery Management Council.

The Act encourages domestic fisheries while discouraging foreign ones. The portion of the "optimum yield" which the U.S. can not harvest and process is distributed among foreign countries which have fishing agreements with the U.S. Allowable harvest levels in the Northwest Atlantic having foreign allocations have been previously described (See FEIS Sale No. 42, Final Supplement, p. 21-32).

5. Endangered Species

Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536, 50 CFR Part 402), requires federal agencies to consult with the Fish and Wildlife Service (FWS) in the U.S. Department of the Interior, and the National Marine Fisheries Service (NMFS) in the U.S. Department of Commerce, NOAA, in order to insure that actions that they may authorize, fund, or carry our do not jeopardize the continued existence of an endangered or threatened species or result in the adverse modification of their critical habitats.

From the date that consultation is initiated, FWS and NMFS have up to 90 days to issue a formal biological opinion. This formal biological opinion assesses whether or not the activities of the requesting agency will jeopardize the continued existence of any affected endangered species and can suggest mitigating measures that would promote the protection of an affected species. Upon receipt of the biological opinion, it is the responsibility of the requesting agency to determine whether or not to proceed with the planned activity. However, proceeding in opposition to a jeopardy finding could violate the Endangered Species Act. Consultation must be re-initiated by FWS, NMFS, or the requesting agency if new information becomes available, the planned activity is modified, or an additional endangered species is identified as being an affected species.

Endangered species that could be affected by proposed Sale No. 52 have been identified in Sections III.B.1.d and III.B.2.c. Impacts on them are discussed in Section IV.C.6. A biological opinion was issued for the North Atlantic OCS Sale No. 42 by both FWS and NMFS in 1978 with NMFS providing an amended opinion in 1979. FWS concluded that OCS oil and gas exploration activities as described in the EIS for Sale No. 42 would not jeopardize the continued existence of any endangered species under their jurisdiction. NMFS concluded that there would be no adverse impact on any species under their jurisdiction, with the exception of the humpback and right whales. In their amended opinions, NMFS stated that there was insufficient evidence available to determine whether the lease sale and resulting activities will jeopardize the endangered right and humpback whales. In addition, certain data gaps were noted by each agency. These data gaps are being addressed by BLM funded studies (see Section I.A.4).

Consultation was initiated for proposed Sale No. 52 and for the entire North Atlantic region on April 22, 1981 (See Appendix F). At that time, the BLM provided background information to FWS and NMFS on the existing lease Sale No. 42 and proposed lease Sale No. 52. In addition, copies of the First Year Cetacean and Turtle Assessment Program Final Report (one of the BLM funded studies) were distributed to aid each agency in preparing their opinions. FWS and NMFS are required to provide the BLM with a formal opinion no later than July 22, 1981 (90 days). The FWS opinion appears in Appendix F.

6. Marine Mammal Protection

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407, 50 CFR Part 216) established a national policy to maintain marine mammal populations at their optimum sustainable level and to protect their marine environments. The Act specifically prohibits the harassing, hunting, capturing, or killing of any marine mammal unless otherwise exempted under provisions of the Act. Title II of the Act charges the Marine Mammal Commission with the responsibility of implementing the objectives of the Act. The Commission reviews the relevant policies and activities of Federal

agencies responsible for protecting marine mammals (i.e., Bureau of Land Management, National Marine Fisheries Service, and Fish and Wildlife Service) and advises each agency of actions that appear necessary to conserve these animals and their habitats.

In December 1976, the Commission reviewed plans for the first North Atlantic oil and gas lease sale (OCS Sale No. 42). The Commission concluded that the available knowledge on the abundance, movements, biology, and life histories of the marine mammals of Georges Bank was inadequate for assessing the impact of offshore oil and gas development. The Bureau of Land Management responded by soliciting and funding three major marine mammal studies: (1) Marine Mammal and Marine Turtle Characterization in the North and Mid-Atlantic Areas, (2) The Effects of Sound on Marine Mammals, and (3) Study of the Effects of Oil on Marine Mammals.

Final reports from study No. 2 and 3 are expected by October 1981 and March 1982, respectively. Although study No. 1 is still ongoing, some results are now available and have been used to prepare this environmental impact statement.

7. Ocean Dumping

Ocean dumping is authorized by Title I of the Marine Protection, Research, and Sanctuarries Act (MPRSA) of 1972. MPRSA was amended in March, 1974, to comply with international agreements on ocean dumping and in November, 1977, to prohibit the disposal of harmful sewage sludge in ocean waters after December 31, 1981. In January, 1981, MPRSA again was amended to prohibit the disposal of harmful industrial wastes in ocean waters after December 31, 1981. The New York sewage sludge dumpsite shown on Visual No. 1 will not be used after December 31, 1981. Continued dumping of materials meeting Federal Environmental Protection Agency (EPA) criteria, however, will be allowed (40 CFR Part 227) at other sites.

Title I: Ocean Dumping is the primary regulatory section of the Act and established a permit program for the disposal of dredged and non-dredged materials. The ocean dumping regulations, which were revised in January, 1977, establishes procedures and criteria for designating and managing ocean disposal sites, and for reviewing and enforcing permits.

Major responsibilities for the designation of all disposal sites and for reviewing, granting and enforcing dumping permits for all wastes except dredged materials rest with the EPA. The Army Corps of Engineers issues permits for disposal of dredged material after determing compliance of the material with EPA's environmental impact criteria (40 CFR 227). However, disposal sites for dredged material are designated and managed by the EPA (U.S. Environmental Protection Agency, 1980).

Within the North Atlantic region, dumping at the two Industrial Waste sites was terminated in 1979. However, dumping still takes place at four dredged material sites (see Visual No. 1). Of these sites, the Portland dumpsite will remain active until formal rulemaking is complete or until February 2, 1983, whichever is sooner. For the other three dumpsites - Marblehead, Boston, and Cape Arundel - interim designations will be extended indefinitely pending completion of studies and determination of the need for their continued use (FR 45, No. 11, January 16, 1980). None of these sites is located near the proposed Sale area.

The only explosives and toxic chemical ammunition dumpsite in proximity to the proposed Sale area is centered at approximately 39¼38'N and 71¼00'W. This is about 21 to 22 miles southwest of the Sale area. As these coordinates are regarded as only approximate indications of the location of dumped materials, special precautions will have to be taken by operators before equipment is placed on the bottom of lease blocks where explosives are believed to exist. A proposed Stipulation which would mitigate any potential hazard to drilling operations from undetonated explosives is contained in Section I.A.4.
No radioactive wastes dumpsites (either formerly or presently in operation) exists within the proposed Sale area. One inactive radioactive wastes dumpsite is located in Massachusetts Bay (see Visual No. 1), and two others are located in the Mid-Atlantic, far to the south of the proposed Sale area.

8. Refinery Proposals

Though numerous new refineries have been proposed for the North and Mid-Atlantic areas, environmental concerns have caused most to become inactive projects. Currently only four "active" plans to increase these regions' refinery capacity: The Pittston Refinery (250,000 B/CD) in Eastport, Maine; the Hampton Roads Energy Company Refinery (175,000 B/CD) in Suffolk, Virginia; the Seaview Petroleum Refinery expansion (an additional 35,000 B/CD) in Paulsboro, New Jersey; and the Swann Oil Refinery (26,000 B/CD) in Cheseapeake, Virginia.

The Pittston Refinery, while still considered an active project, has two concerns which must be resolved before construction can begin. First, it must receive an EPA-water discharge permit, which is currently on administrative appeal to EPA in Washington. Second, a potential dispute exists between the United States and Canada concerning right of access to Eastport, affecting the Pittston Refinery's future receipts of crude.

Hampton Roads Refinery law suits are delaying the development of the refinery development. In one case, the National Wildlife Federation has brought suit against the Army Corp of Engineers for issuing dredging permits for the refinery. In the other litigation, the Norfolk and Western Railroad claims the Hampton Roads Energy Company did not begin refinery construction within the three-year building period stipulated in their lease (Hampton Roads Energy Co., 1981, Personal Communication).

Construction has already begun on the approximately 35,000 B/CD expansion to the Seaview Petroleum Refinery. This additional capacity will be able to accommodate heavy, high sulfur crude. It is expected to be onstream by December, 1981 (Seaview Petroleum Co., 1981, Personal Communication).

With all its permits secured, the Swann Oil Refinery anticipates being onstream sometime in 1983. Construction will begin once design decisions are made (Swann Oil, 1981, Personal Communication).

9. Federal Environmental Research

Research conducted for the Bureau of Land Management has been previously described (Section I.B.1.d). Other research that is being conducted on Georges Bank or related to OCS oil and gas development includes:

Type of Study	Agency/Institution	Status/Delivery*
MARMAP-marine monitoring, assessment and prediction; bottom trawl surveys, phyto-, zoo-, ichthyoplankton and hydrography	NOAA	Ongoing
OCEAN Pulse-monitoring of contaminants, habitats and biota; effects on selected species, water quality, phytoplankton bacteriology	NOAA	Ongoing
MURT-Manned Undersea Research and Technology, observations on shelf, slope and canyon fauna and habitats	NOAA	Ongoing
NE Channel Current Studies	NOAA	Analysis in Progress
North Slope Georges Bank Current Studies	NOAA	Analysis in Progress
Dynamics of Phytoplankton Patches on Nantucket Shoals	National Science Foundation	Ongoing
Sublethal and latent effects of drilling muds on larval and adult crustaceans	University of West Florida (EPA)	FY 81

Type of Study	Agency/Institution	Status/Delivery*
Toxic and sublethal effects of muds and certain chromium compounds in crustaceans	University of West Florida (EPA)	FY 81
Effects of drilling mud constituents on micro-fauna and the base of the marine food web	Florida State University (EPA)	FY 81
Effects of drilling mud on marine organisms	Florida State University (EPA)	Funded in 1981 for 1982
Benthic Characterization Analysis of infauna and seasonal change	Woods Hole Oceano-graphic Institution (EPA)	FY 80
The Erodibility of drilling muds deposited on the sea floor	Yale (University) EPA	March, 1982
Effects of drilling muds on developmental stages of the American lobster	Woods Hole Oceano-graphic Institution (EPA)	FY 82
Feeding, reproduction and habitat selection effects of drilling muds in lab and field situations	Boston University (EPA)	June, 1981
Study of the impacts of discharged drilling fluids on the Georges Bank envi-ronment; chemical analysis of toxic constituents and toxicity tests on marine organisms	New England Aquarium (EPA)	FY 82
Effects of drilling mud on embryo development of fish and echinoderms	Trinity College (EPA)	May, 1982
Effects of drilling muds on the behavior and benthic ecology of three gadidae species (cod family)	NOAA (EPA)	December, 1981

Type of Study	Agency/Institution	Status/Delivery*
Quality Assurance of drilling fluid analysis	National Bureau of Standards	February, 1981
Gulf and Atlantic Surveys (GAS I)-analyze samples fish and shellfish for levels of petroleum chlorinated and polynuclear aromatic hydrocarbons contained in muscle tissue	NOAA	Ongoing
Effects of soluble fractions of drilling fluids on larval development and behavior of *Callinectes sapidus* and *Rhithropanopeus harrissii*	Duke University (EPA)	FY 82
The impact of drilling muds on standing stocks, and metabolic activities of bacteria in sediments	Wayne State University (EPA)	March, 1982
Comparative Structure and Response to Petroleum; Response in Two Coastal Infaunal Communities	EPA	August, 1981

*EPA Studies - Pending Funding

Section 2

Alternatives Including The Proposed Action

II. Alternatives Including the Proposed Action

A. Resource Estimates and Production Schedules

Proposed Sale No. 52 could result in the leasing of a maximum of 540 blocks on the North Atlantic Outer Continental Shelf, and Slope regions. Each block consists of 5,693 acres (2304 hectares) or approximately 9 square miles. The blocks under consideration for leasing comprise a total area of 3.1 million acres (1.2 million hectares). If held, this would be the second sale in the North Atlantic area, but it does not represent proposed development of all of the potential oil and gas resources of the Georges Bank.

Based upon proprietary geophysical data, the U.S. Geological Survey has estimated that if the proposed lease area is hydrocarbon productive, a mean of 1.73 billion barrels of recoverable oil and 5.25 trillion cubic feet of recoverable natural gas may be discovered. These are the conditional mean resource estimates. It is important to bear in mind that these resource estimates are conditional upon the discovery of recoverable hydrocarbon resources in the proposed lease area. The risked mean resource estimates would take into account the possibility that no discovery may be made in the proposed lease area.

The conditional mean resource estimates have been used in this EIS in order to estimate the probable environmental impacts that could be expected to result from oil and gas discoveries from proposed OCS lease Sale No. 52. Changes to these impacts which could result from the high or low resource discoveries are discussed in Section IV.D.

The yearly production rates which could result from the conditional mean resource estimates described above are given in Table II.A-1. The peak daily rate of production which is projected if the area is hydrocarbon productive is 445,000 barrels of oil and 1.42 billion cubic feet of gas in 1997. Production of oil and gas is projected to begin in 1994 and continue for approximately 30 years.

Most of the proposed Sale area lies on the continental slope, seaward of the blocks previously leased in Sale No. 42. When developing the resource estimates for the blocks in proposed Sale No. 52, the USGS re-evaluated the resource potential for the blocks leased in the previous North Atlantic sale. The projected production schedule for these revised resources is given in Table II.A-2.

Undiscovered resources are defined as those quantities of hydrocarbons which are reasonably expected to exist in favorable geologic settings, but which have not yet been identified by drilling. If exploration confirms the existence of recoverable hydrocarbons, such resources would be reclassified as reserves.

Table II.A-1 Yearly production rates which could result from the unrisked conditional mean resource estimates for proposed Sale No. 52

Year	Expl. Wells	Delineation Wells	Plats	Subsea Complxs.	Total Wells Drilled	Production Oil (MB/YR)	Schedule Gas (MMCF/YR)
1983							
1984							
1985	9						
1986	5	15					
1987	3	8					
1988		3					
1989							
1990							
1991							
1992			12				
1993			5				
1994			3	5	82		
1995				8	122	79198	263469
1996				9	138	124987	409016
1997				6	86	146414	466052
1998				3	38	146161	463864
1999					7	134321	417567
2000						120560	371847
2001						108214	331159
2002						97137	294295
2003						87196	262713
2004						78280	234021
2005						70277	208480
2006						63095	185740
2007						56650	165494
2008						50866	147466
2009						45674	131413
2010						41014	117117
2011						36830	104384
2012						33075	93042
2013						29704	82940
2014						26678	73941
2015						23961	65924
2016						21522	58780
2017						19331	52414
2018						17364	46742
2019						15598	41688
2020						14012	37182
2021						12588	33166
2022						11309	29587
2023						10160	26396
2024						9128	23550
2025						5079	12764
2026						2429	5886
2027						813	1959
2028						148	215
	17	26	20	31	473	1,739,773	5,260,273

Table II.A-2 Yearly production rates which could result from the revised conditional mean resource estimates for proposed Sale No. 42

Year	Expl. Wells	Delineation Wells	Plats	Subsea Complxs.	Total Wells Drilled	Production Oil (MB/YR)	Schedule Gas (MMCF/YR)
1982							
1981							
1982	6						
1983	4	3					
1984		2					
1985							
1986							
1987							
1988							
1989		5					
1990		1					
1991				0	25		
1992					25	11690	40090
1993					22	16039	53181
1994					3	15302	50849
1995					3	14631	48723
1996						13297	44469
1997						12084	40589
1998						10982	37047
1999						9981	33816
2000						9071	30868
2001						8244	28178
2002						7493	25723
2003						6811	23483
2004						6190	21483
2005						5626	19573
2006						5114	17870
2007						4648	16315
2008						4225	14897
2009						3839	13603
2010						3490	12421
2011						3172	11342
2012						2884	10357
2013						2621	9458
2014						2383	8637
2015						2166	7892
2016						1969	7205
2017						1790	6580
2018						1627	6010
2019						1479	5489
2020						1345	5014
2021						1222	4580
2022						443	1580
2023						95	348
2024						45	166
	10	11			78	191,998	657,836

B. Description and Summary of the Alternatives

1. Alternative 1: Hold the Sale as Proposed

a. Description

The proposed action is the offering of 540 blocks (see Figure II.B.1.a-1) on the Atlantic Outer Continental Shelf (OCS) for lease in October, 1982 for the purpose of exploration, development, and production of potential hydrocarbon resources in accordance with the Outer Continental Shelf Lands Act (OCSLA), as amended. These blocks are located approximately 86 to 164 statute miles offshore the New England States in average water depths of 171 to 9,285 feet (52 to 2,830 meters). This proposal represents an effort to find new domestic sources of oil and gas and to obtain an increased degree of national energy independence.

The U.S. Geological Survey (USGS) is currently analyzing tract-specific, geophysical data for the purpose of identifying any adverse geohazards located within the proposed Sale area. The results of the analysis will be made available to BLM in time for inclusion in the Final Environmental Impact Statement (FEIS). At that time, USGS will recommend deletion of tracts or stipulations to mitigate any hazards present. A deletion alternative regarding tracts containing possible sediment slumps appears in Section II.B.8: Alternative 8. This alternative is based on BLM's interpretation of preliminary data and information supplied by the USGS. The tracts are subject to change pending the results of the USGS tract specific report.

Many variables may affect the amount and location of commercial activity which may be generated in the North Atlantic as a result of this proposed sale. Chief among them would be the amount and location of total proven reserves. In addition, the ratio of oil to gas, geologic, socio-economic, and other parameters will affect the number and location of platforms, wells, and onshore facilities required to develop a given amount of hydrocarbon resources.

In order to assess the environmental impacts of this proposal, certain assumptions have to be made about the development pattern resulting from the proposed Sale. These development assumptions relate to the projected size and location of facilities for transportation, operations support, gas treatment or processing, petroleum refining, pipecoating and platform and subsea complex construction. These assumptions are explained in Appendix C; they should not be regarded as rigid predictions of future events.

Figure II.B.a-2 shows the projected routes and locations of facilities for the conditional mean resource estimate scenario in which tanker transportation for oil and pipeline transportation for gas are considered the

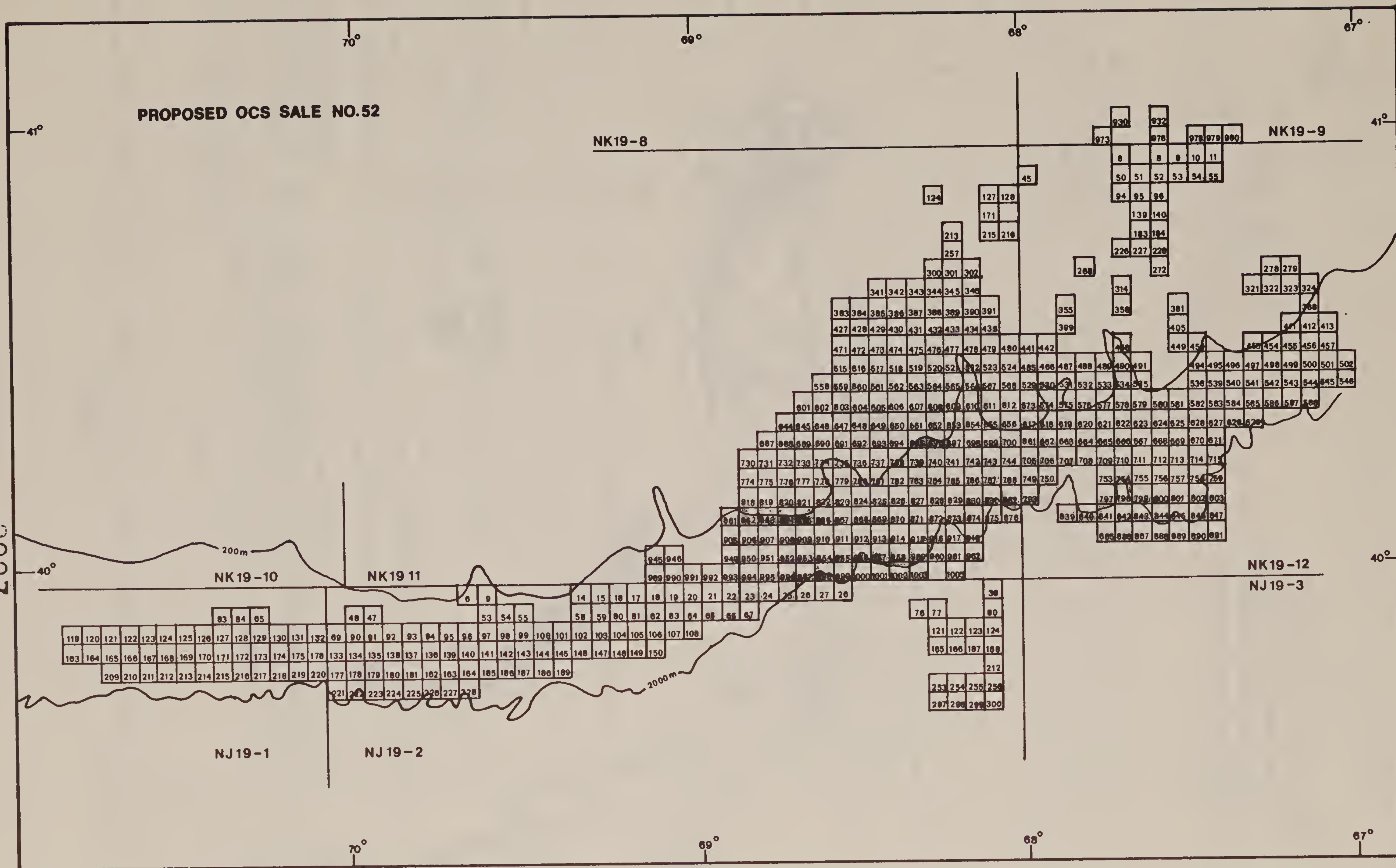

Figure II.B.1.a-1. The Proposed Action, 540 Tracts to be Offered in Proposed Sale No. 52

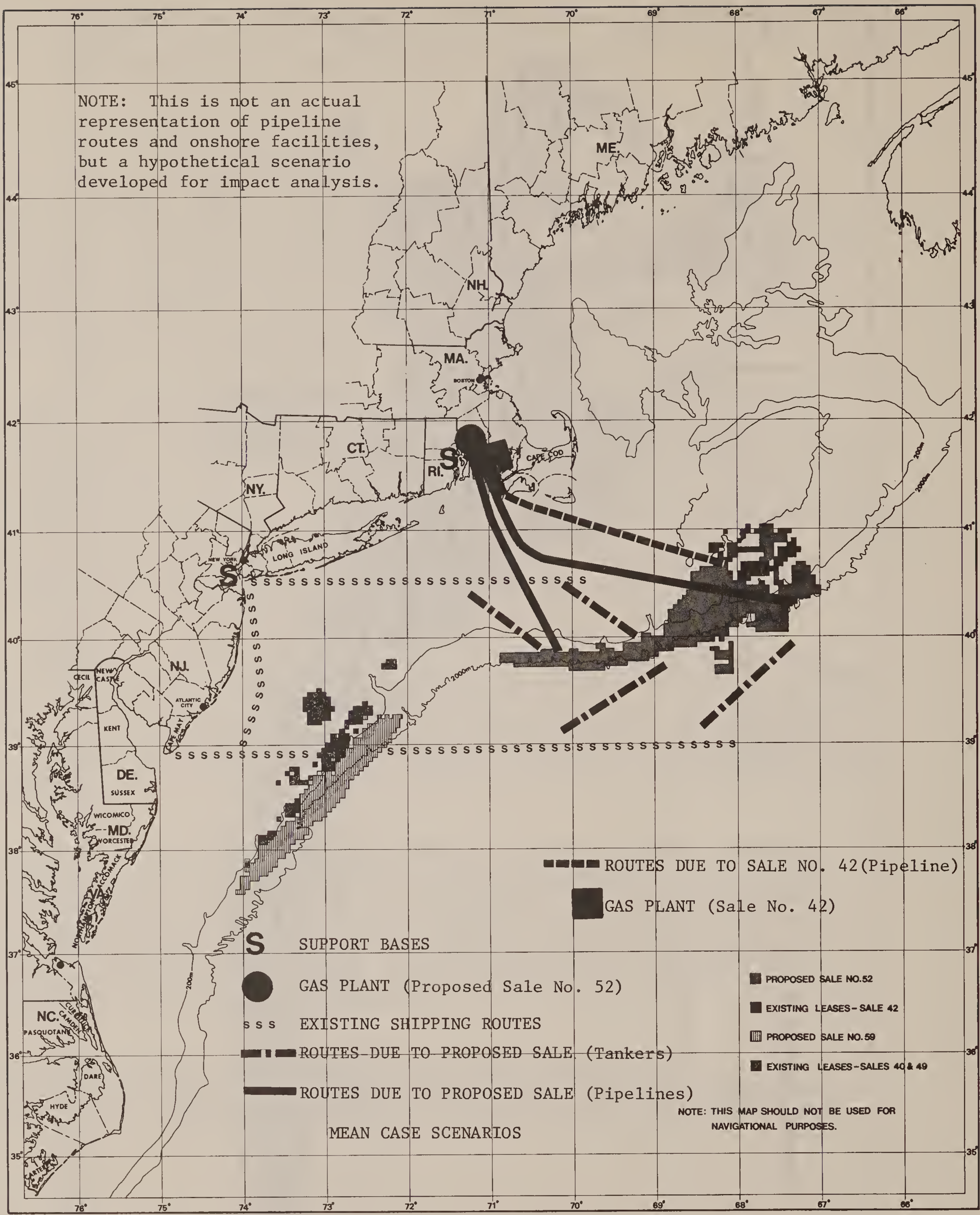

Figure II.B.1.a-2

most likely modes of transportation to result. It also shows those facilities assumed to result from North Atlantic Sale No. 42. Possible transportation scenarios other than the most likely are described and summarized in Section IV.D.

Resources: It is assumed that the conditional mean level of resources would be produced. This amounts to a total of 1.73 billion barrels of oil, with peak production of 445,000 barrels per day occurring in 1997, and 5.25 trillion cubic feet of gas with peak production of 1.42 billion cubic feet per day occurring in 1997.

The number of wells per year, year of installation of platforms and subsea complexes, and the production schedules are given in Table II.A-1. An estimated 20 platforms and 31 subsea complexes would be required to produce the resources. A total of 17 exploratory wells, 26 delineation wells, and 473 production wells (including expendable wells) could be drilled. Similar information for Sale No. 42 is given in Table II.A-2.

Transportation: The most likely transportation mode is considered to be pipelines for the gas, and tankering for the oil. It is assumed that all phases of the pipeline industry could meet the water depth challenges involved (see Appendix G - Deepwater Technology), within the development time frames. Two 36" diameter gas pipeline would be required to transport the mean level of this resource. The oil resources, are assumed to be transported by tankers to refineries in the Raritan and Delaware Bays (see Appendix C - Explanation of Assumptions). Some mileage of oil pipelines may be involved - mostly gathering lines - in connection with platforms and subsea complexes. It is also assumed that crude oil produced would replace imported crude. Expansion of refineries would not be required in the mean case.

Gas Pipelines: Two pipelines, each 36" in diameter and totalling approximately 350 miles in length offshore, could be laid. Along the route of each, a gas compressing station would be located at a depth suitable for a conventional bottom-founded platform. The assumed landfall for the gas pipelines is Little Compton, R.I. Onshore, the pipelines could travel approximately 25 miles through Newport County, R.I. and Bristol County, MA. to the Fall River area of Bristol County. Both pipelines could share the same right-of-way. Sale 42 is assumed to result in one 24" in diameter gas pipeline. It is assumed to share the same landfall and have an adjoining right-of-way with the proposed Sale No. 52 pipelines.

Gas Processing Plants: The gas from proposed Sale No. 52 is assumed to be processed in Bristol Co., MA. The capacity of the gas processing plant would be 1.42 BCF/D. The gas from Sale No. 42, would be processed in an assumed gas plant also in the vicinity of Fall River, Bristol Co., MA.

Operations Support Bases: Operations support could be provided from Davisville, R.I. and Stapleton, N.Y. (Staten Island), and the helicopter support from the Barnstable Muicipal Airport in Barnstable Co., MA.

Pipecoating: An existing facility in Fairless Hills, Buck Co., PA, could be used for pipecoating.

Platform Fabrication and Subsea Complex Construction: Any platforms or subsea complexes needed as a result of this proposed sale could be fabricated outside of this region.

b. Summary of Environmental Consequences

USGS estimates that the leasing of the 540 tracts in proposed Sale No. 52 may result in 10 oil spills greater than 1000 barrels each. (See Sect. IV.A.5 and Appendix D for an explanation of the results of the Oil Spill Trajectory Analysis Model (OSTAM) run for proposed Sale No. 52). Spills occurring in the proposed lease area have a minimal chance of contacting nearshore or onshore vulnerable resources. However, oil spills are more likely to occur during the transportation of the oil than during its production. The resources along the hypothetical Sale 52 tanker route to Raritan Bay appear to be the most vulnerable.

Degradation of offshore air quality would be minimal and localized. Pollutants would be diffused rapidly in the offshore air mass. Impacts to offshore water quality, which would also be localized and temporary, would be due to: discharges of drilling muds and cuttings, formation waters, and domestic and sanitary wastes; to oil spills, both acute and chronic; to sediment disturbance during pipeline installation, and to gas blowouts and gas line breaks. Approximately 11.6 million barrels of drilling muds and 1.8 million barrels of cuttings could be discharged over the life of the field, according to USGS estimates, and between 1.6 and 3.2 million cubic yards of sediment could be disturbed by pipe laying operations (Table IV.C.2-1). Depending on local hydrographic features, affected areas would return to normal through processes of dispersion, transport and degradation.

Any impacts on planktonic and benthic communities would be localized and temporary. The effects of chronic discharges on phyto-, zoo-, and ichthyoplankton should be of a minor nature.

Most of the commercially important fishery resources occur on the continental shelf and along the shelf break, nearer to shore than the majority of the proposed sale area. A catch loss model has been developed to assess the space and use conflicts between the fishing and oil industries. The catch loss model run for the proposed Sale No. 52 mean case shows the greatest percentage of area that could be lost would be 2.9% in the groundfish

fish otter trawl fishery and the greatest percentage of catch that could be lost would be 0.3% in the lobster otter trawl fishery. Fishery resources in the vicinity of the Georges Bank crest area face a very high probability (75.0%) of being impacted by one or more oil spills over the expected production life (approximately 30 years) of the field. Although areas open to foreign fishing overlap the proposed lease area, little conflict between OCS oil and gas activities and foreign fishing in the North Atlantic is expected.

Of the endangered and threatened species found in the region, activities from the proposed sale may adversely impact the loggerhead and leatherback turtles during their migration periods. A Sale No. 52 tanker spill could pose a moderate threat to peregrine falcon migratory stop-over areas. Six species of endangered whales can be found in the region at varying times during the year and the impacts on these whales from sale related activities are uncertain.

A spill resulting from the proposed sale could cause population declines for some species of pelagic birds. Coastal bird species and wintering sea ducks in the vicinity of Marthas Vineyard and Nantucket Island face a high probability of being impacted by an oil spill from the proposed Sale over the production life of the field.

Sensitive coastal areas, such as bays, estuaries and barrier islands would only be temporarily disturbed by pipeline construction, but could be impacted adversely by contact with an oil spill. The areas most vulnerable to an oil spill include the south shore of Long Island, Martha's Vineyard, and Nantucket Island.

The greatest risk to coastal recreation resources from proposed Sale No. 52 is from oil spills. The areas with the highest probability of being impacted adversely are Nantucket Island, with a 25% chance, and Martha's Vineyard, with a 20% chance of being contacted within 30 days by a spill greater than 1000 barrels over the assumed 30-year production life of the leases resulting from the proposed Sale. Transportation of the oil presents a greater risk to coastal recreation than drilling and production, with the greatest risk occurring along coastal recreation areas on Long Island, as well as those on Nantucket Island and Martha's Vineyard. Construction of natural gas pipelines through beach recreation areas should have only short-term impacts as long as construction is timed for the off-season and the affected areas are restored. No drilling operations will be visible from shore.

If the facilities resulting from this proposed Sale are sited as assumed in this DEIS, few conflicts with land use plans and policies should occur. Pipeline rights-of-way may utilize existing rights-of-way and support bases and gas processing plants should be sited in areas currently zoned for industrial development.

Proposed Sale No. 52 could result in a maximum employment increase on a regional basis of less than one percent, with a peak year addition of 7,120

jobs in 1996. Counties which could experience the greatest number of added jobs are those in which operations support bases and gas facilities are assumed to be sited. Although the level of economic activity that is forecast may be absorbed on a regional basis without disruption, it is possible that employment and population changes induced by proposed Sale No. 52 may result in a temporary strain on some communities.

Onshore development could result in some degradation of air quality, particularly near sites of the projected gas processing plants and operations support bases. Minimal impacts on water quality could occur from discharges of domestic and industrial wastes due to economic growth and increased population resulting from the proposed sale. Sale-related facilities and induced development could increase water consumption within areas where they are located.

c. Cumulative Impacts

Activities which are likely to cause cumulative impacts with proposed Sale No. 52 include other Atlantic OCS lease sales and activities in other areas which may affect migratory species using the lease sale area.

In Section IV.C, cumulative impacts have been discussed only under Alternative 1: the Proposal, because the greatest degree of cumulative impacts could occur under this Alternative. Cumulative impacts under the other Alternatives, except for Alternative 3: Cancel the Sale, would be similar in kind, but reduced in degree from those discussed under Alternative 1.

Atlantic Lease Sales: At present, there are three leasing regions off the Atlantic coast. Their geographical relationship is shown in Figure II.B.1.c-1.

In the North Atlantic, 63 tracts were leased in Sale No. 42 in December, 1979, but exploration has not begun. The second sale in this region, proposed Sale No. 52, is tentatively scheduled for October, 1982.

In the Mid-Atlantic, two sales have already been held. Sale No. 40, held in August, 1976, resulted in 93 leases, and Sale No 49, held in February, 1979, in 39. Exploratory drilling in the Mid-Atlantic began in March, 1978 and is continuing. There have been some encouraging gas shows, but no discovery has been announced that would warrant development and production. In conjunction with the IPP Mid-Atlantic Technical Working Group, the New York OCS Office has prepared a Transportation Management Plan to guide any such development when it occurs.

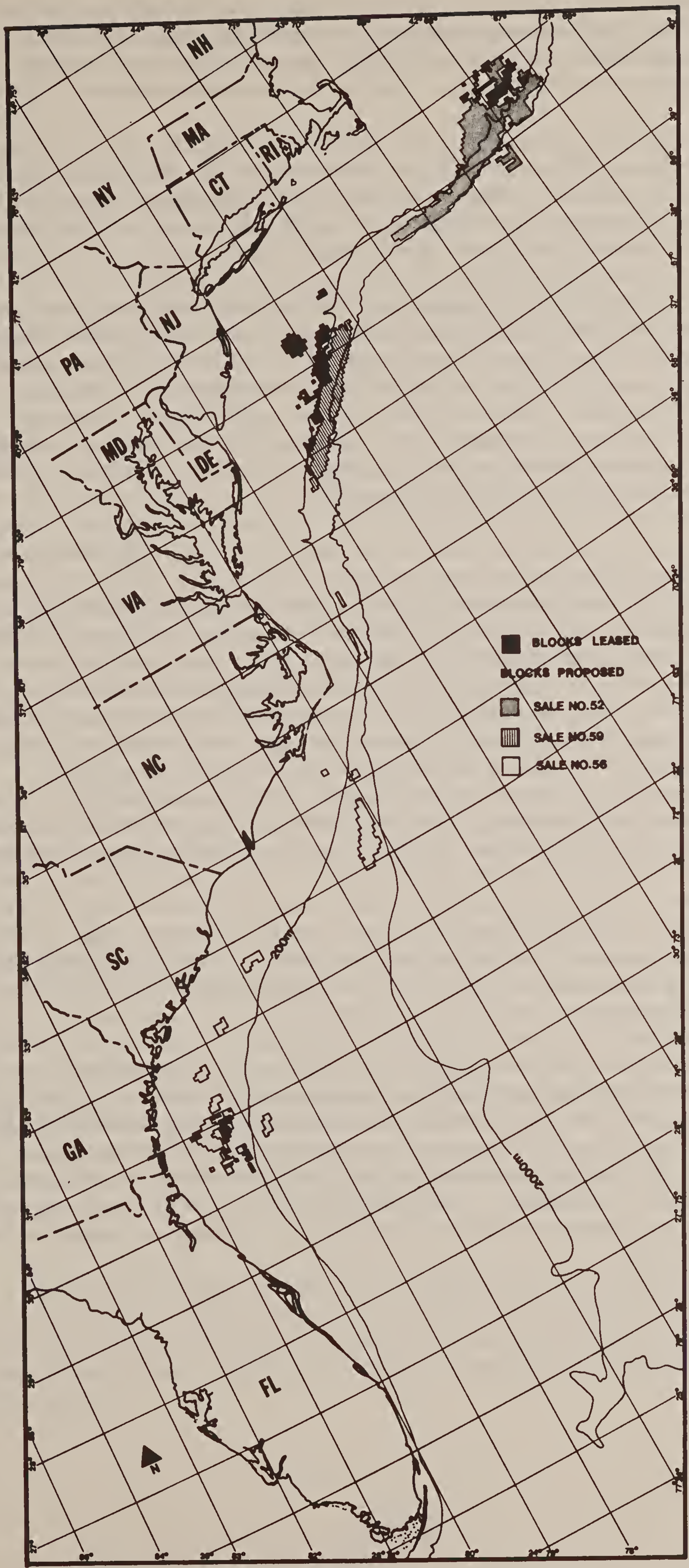

Figure II.B.1.c-1.
Location of Atlantic
Leasing Activity

In the South Atlantic, 43 tracts were leased in Sale No. 43 in March, 1978, and proposed Sale No. 56 is tentatively scheduled for August, 1981. Six exploratory wells were drilled as result of Sale No. 43 between May, 1979 and February, 1980. There were no hydrocarbon shows.

Certain migratory species could be more severely impacted by drilling activities in all three Atlantic leasing areas than if drilling occurred in the North Atlantic alone. This potential for cumulative adverse impacts could be particularly severe for endangered species, such as the peregrine falcon, leatherback sea turtle, and right whale.

For most resources, cumulative impacts with other OCS oil and gas lease sales would result from the activities associated with the prior North Atlantic Sale No. 42. Even then, impacts on most offshore resources would not be significantly different than thos expected as a result of proposed Sale No. 52 alone. This is due to the much larger resource estimate projected for the proposed sale compared to the leased tracts and, therefore, a greater level of projected activity to explore, develop, and produce the proposed Sale No. 52 resources.

Fishery resources in the Georges Bank crest area will be exposed to a greater risk of being impacted by one or more oil spills when the cumulative effects of Sale 42 and proposed Sale 52 are considered jointly. Commercial fishermen may be excluded from more area in the North Atlantic as the area around the projected pipeline for resources from Sale 42 would be added to that area required for the two pipelines projected for proposed Sale No. 52. The increased number of drilling rigs and production platforms may also reduce, to a lesser extent, the area available to commercial fishermen. Fishing activities in the Mid- and South Atlantic regions should not be affected by oil and gas activity in the North Atlantic unless OCS tankers from the North Atlantic bound for the Raritan and Delaware Bays incur an accident in the Mid-Atlantic region.

There is an increased risk of an additional oil spill resulting in the cumulative case. The expected number of oil spills greater than 1,000 barrels projected as a result of proposed Sale No. 52 and from Sale 42 is 11. The majority of these spills (10) are expected to result from proposed Sale No. 52 alone.

Existing tanker transportation of imported crude oil and refined petroleum products in the North and Mid-Atlantic is expected to result in 93 oil spills greater than 1000 barrels each over the production lives of the fields. To the extent that OCS oil replaces imported oil, the risks associated with OCS oil would be substituted for the risks associated with the transportation of oil imports. Approximately, all oil that might be produced in the North Altantic is assumed here to replace a roughly equivalent amount now imported.

Some impacts from Mid-Atlantic Sale No. 59 could be cumulative with those impacts from proposed Sale No. 52 because operations support for both the North and Mid-Atlantic leases, at least initially, will be from Davisville, RI, and any oil produced as a result of Sale No. 59 would also be refined in the Mid-Atlantic.

The additional jobs caused by Sales 40, 49 (2,570), 42 (570), and proposed Sale No. 59 (17,430) would make the peak year regional increase 27,690 in 1996 instead of 7,120 from proposed Sale No. 52 alone. This is a cumulative impact of one quarter of one percent over the level of employment which would occur in the North-Atlantic region without OCS development. Of these 27,690 additional jobs in 1996, over 50% are projected for Washington County, RI. This is due to the supply base in Davisville which is to be used for both Mid- and North Atlantic operations support. Such an increase represents a significant increase in the current labor force.

Migratory species: In addition to possible impacts from OCS oil and gas activities in other Atlantic leasing regions, migratory species of birds that pass through the North-Atlantic can also be impacted by loss of onshore breeding, migratory stopover, and overwintering habitats from private and recreational development of coastal areas.

All species of endangered or threatened sea turtles which occur in the North-Atlantic experience moderate to high mortality rates caused by commercial fishermen in the Gulf of Mexico and along the southeastern coast of the U.S., and natural and man-induced predation of turtles and eggs on nesting beaches in the Gulf of Mexico/Caribbean Sea region. Sale No. 52 related OCS activities will cause a small, but additional, adverse impacts on these species.

Hunting of some whale species adds to the possible impacts on endangered populations caused by OCS oil and gas activities. Hunting quotas have been set by the International Whaling Commission for the humpback and sperm whale populations that are thought to transit the North-Atlantic leasing region.

The net effect of these impacts in conjunction with oil and gas activities could inhibit the return of each endangered or threatened species to a non-endangered status or further reduce existing populations. However, both the Fish and Wildlife Service and the National Marine Fisheries Service in their biological opinions pursuant to the Endangered Species Act of 1973 have determined that the leasing and exploration activities associated with proposed OCS lease sales in the Mid-Atlantic region are not likely to jeopardize the continued existence of any endangered or threatened species. Biological opinions for the North-Atlantic region are included in Appendix F.

d. Mitigating Measures Included in the Proposal

Standard mitigating measures which are in place include those mandated by the OCSLA, such as the Oil Spill and Fisherman's Compensation Funds (Appendix H), oil spill containment and clean-up equipment and contingency plans (see below), and OCS Operating Orders and Notices to Lessees and Operations.

OCS Operating Orders supplement regulations and detail requirements and specifications for oil and gas operations. They outline permit requirements, engineering criteria, survellance and testing procedures, and information requirements. They are developed and administered by the U.S. Geological Survey. The USGS summary and analysis of North-Atlantic OCS Operating Orders is included in Appendix E.

Under the post-lease regulatory authority of the USGS Conservation Division, lessee are required to obtain detailed site-specific geologic hazards information over locations on leased tracts where exploration or development activities are proposed. This mandatory requirement is imposed on all lessees to assure safety of operations prior to approval of Exploration Plans. The extent and degree of geologic hazards investigation required of the lessee is at the discretion of the appropriate Deputy Conservation Manager, who is charged with approval of the safety of OCS operations. The general procedures to be followed by the lessee in conducting site-specific geologic hazards surveys are set forth in various Notices to Lessees and Operators (NTL) issued by the Regional offices of the Conservation Division. The NTL and applicable lease stipulations serve as guidance for minimum requirements and in no way restrict the authority of the Deputy Conservation Manager to impose additional requirements on the lessee when necessary. Information on how the post-lease regulatory authority of the USGS will be used to help mitigate any special conditions resulting from the deepwater aspects or potential geologic hazards associated with proposed Sale No. 52 follows.

i. Oil Spill Containment and Clean-up

Within the North Atlantic region oil spill containment and clean-up planning and implementation are provided by Federal agencies, the States, private contractors, and the industry cooperative Clean Atlantic Associates (CAA).

The framework for a coordinated Federal spill response and clean-up is detailed in the National Contingency Plan (40 CFR Part 1510). Those Federal departments and agencies charged with the responsibility for implementing the plan are the Departments of Agriculture, through the Forest Service; Commerce, through NOAA; Defense, through the Corps of Engineers; Interior, through the Geological Survey and the Fish and Wildlife Service; Transportation, through the Coast Guard; and the Environmental Protection Agency. The Federal responsibility for actual oil spill clean-up is assumed by the U.S. Environmental Protection Agency and the U.S. Coast Guard through an On-Scene Coordinator. The Coast Guard usually deals with those spills occurring offshore.

Within the Federal framework, there exists a National Strike Force with three Strike Teams. The closest one to the proposed Sale No. 52 area is the Atlantic Strike Team, located in Elizabeth City, North Carolina. Besides acting in an advisory capacity to the On-Scene Coordinator, the National Strike Force, through its Strike Teams, assists in clean-up

operations during a major spill determined to be a federal clean-up responsibility. In the event of a catastrophic spill, all equipment of the National Strike Force could be mobilized by the On-Scene Coordinator.

National Strike Force equipment is available via rapid transportation, including air, to the port nearest the spill. For the Argo Merchant spill, in spite of adverse weather conditions, the response time for the Atlantic Strike Team to reach the spill site was approximately seven (7) hours (U.S. Coast Guard Correspondence, February 3, 1981). This was due to the relative ease of transporting the offloading pumping system typically used to deal with vessel incidents. However, a spill resulting from a well blowout and requiring larger, heavy skimming barriers would require a longer response time - approximately 13 to 18 hours for a spill within the proposed Sale area (U.S. Coast Guard, Personal Communication, 1981). Table I.C.1 contains a list of equipment maintained by the U.S. Coast Guard Atlantic Strike Team.

Responsibilities of Regional Response Teams are also set out in the National Contingency Plan, and include planning and preparedness action before a pollution discharge occurs and coordination and advice during the period of a pollution discharge (Dept. of Commerce, OCZM, correspondence, February 2, 1981). Coast Guard personnel monitor all containment and recovery activity to certify that it has been done appropriately. The Coast Guard monitors clean-up procedures even in cases where the owner of the facility producing a spill is responsible for hiring the clean-up crews.

The first U.S. Coast Guard District in Boston maintains equipment for harbor clean-up and, in the future, may maintain open sea, clean-up equipment (eg: skimming barriers) from the Atlantic Strike Team stockpile for offshore operations. If skimming barriers are maintained in Boston, the Coast Guard could have the equipment on-site within the proposed Sale area 10 to 15 hours after notification of a spill (U.S. Coast Guard, Personal Communication, 1981).

The State of Massachusetts has a formal contingency plan that involves contracting with private companies for clean-up. In addition, under the Massachusetts Oil Spill Contingency Planning Program, state, county, and local officials have joined forces to develop regional oil spill contingency plans which include trained Local Response Teams and the purchase of oil spill containment equipment for local use (Garry, 1981). This plan is in line with the revised National Contingency Plan that provides for the development of local contingency planning with special emphasis on environmentally sensitive areas.

The State of Maine administers an extensive clean-up contingency plan, while Rhode Island has no state plan, instead relying on Coast Guard plans. Rhode Island, however, maintains its own system of notification for response to spills and also has access to clean-up contractors.

In Boston and Portsmouth Harbors and along Long Island Sound there are small clean-up cooperatives to deal with nearshore spills associated with port facilities.

OCS Order No. 7 requires that prior to exploration offshore operators must have an approved contingency plan that ensures the availability of spill containment and clean-up equipment and trained personnel. This equipment is to be maintained either at or near the drill site or onshore within the area, at the discretion of the USGS Deputy Conservation Manager on a case-by-case basis.

In addition to the government contingency planning entities, there exist private oil spill containment organizations and clean-up cooperatives which have equipment and trained personnel on hand to combat spills. The major private clean-up cooperative for the North Atlantic region is Clean Atlantic Associates (CAA), an oil industry cooperative based at Davisville, Rhode Island. Membership now includes 15 companies presently holding offshore oil and gas leases in the Atlantic and is open to additional companies that acquire leases in subsequent Atlantic sales. The primary objectives of CAA are to provide and maintain oil spill containment and clean-up equipment for use by member companies and to help ensure the availability of trained personnel for cleaning up oil spills.

Table I.C.2 contains a list of equipment maintained by CAA at Davisville, all of which would be available for use in both the Mid and North Atlantic. Dispersants, however, could be used only with approval of the Federal On-Scene-Coordinator and with EPA concurrence. The largest spill that could be dealt with effectively by CAA equipment is 1000 barrels-per-day.

In compliance with OCS Order No. 7 the first drilling rig on-site within the presently-leased Georges Bank area will maintain on board a state-of-the-art Offshore Devices skimming barrier, a Fast Response Unit, and a Dracone Flexible Barge as well as have personnel trained to initiate the clean-up response and deploy the equipment. The second drilling rig offshore shall maintain a Fast Response Unit and a Dracone Flexible Barge.

Equipment would be maintained offshore for the duration of drilling in the North Atlantic and thereby could provide rapid cleanup response for a spill within the proposed Sale area. For operations in the already leased Sale No. 42 area, the USGS requires industry to provide a maximum 6-hour response time capability in deploying the offshore equipment. Additional clean-up equipment from Davisville could be loaded and on-site approximately 18-20 hours after notification of a spill (USGS, Personal Communication, 1981).

The appropriate response to an oil spill within the region would depend on the physical and chemical properties of the oil and the extent to which

the oil spreads, evaporates, disperses, or forms water-in-oil emulsions. Many treatment methods exist, and include mechanical recovery, chemical dispersal, sinking, absorbing, and burning.

The important limiting factor concerning equipment efficiency and effectiveness is the sea state, primarily wave height, which depends largely on wind conditions. Current state-of-the-art equipment is capable of mechanical containment and recovery operations in 8-10 foot seas and 20 knot winds but may exceed those limits in certain circumstances (U.S. Coast Guard Correspondence, April 9, 1981). This equipment, the Offshore Devices, Inc. skimming barrier system, was used by the National Strike Force for containing oil from the Ixtoc I blowout in the Bay of Campeche. There, it exceeded specified operational and survivability parameters by containing and recovering oil successfully in 12 foot seas and 40-knot winds without significant failure of any physical barrier component (O'Brien, 1981). A recovery rate of approximately 300 gallons per minute was observed (U.S. Coast Guard Correspondence, April 9, 1981).

Wave heights equal to or greater than 10 feet within the proposed Sale area occur approximately 15 percent of the time during winter, the time when highest wave heights are observed. However, wave height alone does not determine sea conditions, nor the clean-up capability of equipment. Currents and weather conditions must also be taken into account. Because sea conditions vary within areas of the Georges Bank region, clean-up capability and effectiveness would vary, depending on where an oil spill occurred.

Roughest seas in the region are assumed to occur on top of Georges Bank, approximately within the 60-meter isobath. This is an area of great turbulence where current velocities up to 75 cm/sec and wave heights of 11 to 12 meters have been recorded (EG&G, 1979; Neu, 1972). If a spill occurred under rough sea conditions here, clean-up would be difficult, and probably not feasible, depending on circumstances. Rough seas, however, would break up an oil slick, and turbulence would disperse the oil in the water column. This, in turn, could enhance evaporation and weathering. Only 7 blocks offered under the proposed Sale are located within the 60-meter isobath. Thus the likelihood of a spill occurring here is quite small.

The OSTAM (Oil Spill Trajectory Analysis Model) results indicate, however, that if a spill should occur within adjacent areas, there is a high probability that the spill would eventually strike the crest of the Bank (see Appendix D, Tables 3 thru 8).

Conditions on the slope, where most of the blocks for the proposed Sale are located, are less rough. Current velocities here are greatly reduced - on the order of 15-16 cm/sec - and turbulence lessened due partially to the great depths of the water column. In this region, then, circumstances would not cause exceptional problems in cleaning up an oil spill once the equipment is on site.

CCA has recently acquired two Offshore Devices skimming barriers for use in the North and Mid-Atlantic sale areas. As described earlier, one of these units is to be maintained at Davisville and the other offshore within the North Atlantic lease area where it would be available for immediate response.

In addition, the Atlantic Strike Team in Elizabeth City presently maintains one complete Offshore Devices system, and by the end of 1981 will have a total of 11 complete systems, two of which may be maintained by the First U.S. Coast Guard District in Boston. The Strike Team would deploy its equipment if the local On-Scene-Coordinator determined that CAA resources were insufficient to deal with a particular spill.

Finally, the USGS is authorized under 30 CFR 250.12 to suspend operations when extreme weather conditons threaten damage ot life or property. Under such conditions, then, the USGS could closely monitor operations and specify appropriate actions (U.S. Coast Guard Correspondence, February 3, 1981).

Table I.C.1

U.S. Coast Guard Atlantic Strike Team Current and 1981 Projected Equipment Stockpile

Item	Description	Quality
Offshore Devices, Inc. Skimming Barrier	Containment/skimming	11
Lockheed Open Water Oil Recovery System	Open sea skimming	1
Air Deliverable Anti-Pollution Transfer System	Vessel cargo offloading	4
Dracone Flexible Barge	Recovered oil storage	7

Source: U.S. Coast Guard, Personal Communication, 1981.

Table I.C.2

Clean Atlantic Associates Equipment
And Materials For the North And Mid-Atlantic

Item	Description	Quantity
Offshore Devices, Inc. Skimming Barrier	Containment/skimming	2
Fast Response Unit Model I	Bay & open sea skimming	2
Fast Response Unit Model II	Bay & open sea skimming	4
Dracone Flexible Barge	Recovered oil storage	2
Kepner Open Sea Boom - 1000 ft.	Oil Containment	2
Goodyear Open Sea Boom - 1000 ft.	Oil Containment	1
Kepner Rapid Deployment Boom - 1500 ft.	Oil Containment	1
Boat Spray Unit	Oil dispersement	3
Radio Communications System	Clean-up coordination	1
Bird Scarers (Set of 12)	Bird protection	4
Helicopter Spray Units	Oil collectant dispensing	3
Corexit #9627	Dispersant	2500 gallons
Corexit OC-5	Collectant	500 gallons

Source: USGS, Personal Communication, 1981; Clean Atlantic Associates, Personal Communication, 1981.

ii. Deepwater Oil and Gas Operations (Mitigating Measures)

A major concern has been the extreme water depths found within the sale area and the associated proposed technologies for production of oil and gas. The technologies are discussed in detail in Appendix G.

Aside from the various devices required on any drilling operation (the subsurface safety valves and BOP's mentioned previously within this section), OCS Operating Order No. 8 requires, within the context of the OCS Platform Verification Program (PVP), that all new OCS structures be evaluated in terms of their structural integrity.

The PVP was designed primarily to evaluate proposed technologies intended for use in frontier OCS areas. Thus, guyed towers, tension leg platforms, and subsea completion systems proposed for installation within the proposed sale area will be carefully analyzed and evaluated prior to any actual emplacement. Aside from the proposed structures, actual drilling and production activities in deepwater are not significantly different from shallower water operations.

The main purpose of the Platform Verification Program is to provide maximum assurance of the structural integrity of offshore oil and gas platforms. This means ensuring the survivability of offshore platforms so that structural failure will not be the cause of pollution, waste of natural resources, or injury or loss of life. This will be accomplished

by ensuring that reasonable precautions have been taken by the lessee in the consideration of: pertinent local and regional environmental, geological, geophysical, and bathymetric conditions; design procedures; fabrication procedures; and installation procedures.

The Platform Verification Program is intended to: identify and assess the risks associated with a proposed development so that attention is focused on critical areas; be flexible enough to accommodate a variety of installations and OCS regions; have clear, attainable, and enforceable requirements; require the use of proven technology, without inhibiting innovation; and have a minimal impact on both costs and schedules.

The USGS regulations require that all new fixed or bottom-founded oil and gas platforms to be installed on the OCS of the United States, or major modifications or repairs to existing oil and gas platforms, be subjected to a comprehensive verification process to ensure their structural integrity. In addition, it is required that existing oil and gas platforms be adequately maintained.

The Platform Verification Program is an integral part of the review and approval process for Plans of Exploration and Plans of Development/Production in addition to addressing platform design, fabrication, and installation. The major thrust of the Program is intended to be for new fixed or bottom-founded oil and gas platforms in frontier areas (e.g., proposed Sale No. 59), those subject to unusual or extreme environmental conditions, or those incorporating unusual or innovative features. The main elements of the Program are:

- the Platform Verification Section (the technical in-house staff); and

- the Certified Verification Agents (independent third-party experts).

The Platform Verification Program is a mandatory program of the USGS and this responsibility of the USGS cannot be redelegated. However, independent third-party experts who are evaluated and certified by the USGS, and who are selected from an approved list and hired by the lessee, will be utilized in the verification process. Such experts will be evaluated and certified on the basis of technical competence and demonstrated experience in offshore engineering. The technologies involved in implementing the Program entail representation from such diverse disciplines as structural engineering, soil mechanics, geology, geophysics, oceanography, meteorology, hydrodynamics, quality assurance, statistics, and computer science.

The Certified Verification Agents (CVA's), the name given to these independent third-party experts, will primarily be involved with the detailed structural aspects of platform design, fabrication, and installation. The USGS Platform Verification Section will be responsible for the overall management of the Program, certification of CVA's, providing technical reviews and recommendations

on lessee's applications (including Verification Plans), auditing CVA activities, performing limited in-house design, fabrication, installation and structural inspection audits, resolving disagreements between CVA's and industry representatives, assisting in the investigation of accidents involving the structural integrity of platforms, and updating and revising the Program requirements.

In summary, all proposed deepwater operations and drilling or production equipment will be examined within the context of the OCS Platform Verification Program. This Program, along with the safety devices required under various Operating Orders, should be effective in preventing damage to the environment or loss of human life during installation and operation of pioneer deepwater technologies.

iii. Lease Stipulations

Stipulations are developed on a sale-specific basis for conditions or resources identified during the environmental assessment process which are believed to warrant special regulation. In general, recommendations for stipulations and alternative mitigating measures are first considered by the BLM OCS Office, in consultation with the regional offices of the Geologic Survey's Conservation Division and the Fish and Wildlife Service, in accordance with Departmental Manual Part 655 DM 1 detailing inter-bureau coordination procedures for OCS leasing activities. Prior to inclusion in the Secretarial Issue Document and the Proposed Notice of Sale, inter-bureau consultation is also undertaken at the headquarters level. The final decisions on inclusion of stipulations and alternative forms of stipulations are made by the Secretary in the final Notice of Sale.

The following is a list of proposed stipulations for inclusion in the proposed Sale No. 52 Notice of Sale. These stipulations are taken into account as part of the proposal in the environmental analysis that follows.

Cultural Resources Stipulation

Stipulation No. 1 covers the protection of cultural resources. This stipulation has been widely accepted throughout all OCS areas. Inclusion of the cultural resources stipulation would minimize the probability that a valuable cultural resource would be adversely impacted by this lease proposal. The provisions of the stipulation ensure that if a lease tract is likely to contain a significant cultural resource, measures will be taken either to avoid disturbance of that resource or to identify the resource and ensure its preservation if it is determined to be significant. Also, the provisions of the stipulation assure professional involvement in the interpretation of data collected.

The New York OCS Office has funded a study, done by the Institute for Conservation Archaeology at Harvard University, to determine the probability of occurrence of cultural resources in the North Atlantic. The study results indicate that those tracts in water depths less than 200m are thought to have been above sea level at some time, and thus have a possibility of

containing prehistoric sites. However, this possibility is very low (see Section III.C.6). The Georges Bank area has been extensively reworked, not only by the last transgression of the sea, but also by the intense tidal and bottom current regimes present today. Thus, the chance of preservation of a subaerial surface that was exposed on the Bank between 15,000 and about 10,000 year B.P. (Before Present) is extremely low.

Based on the extremely low probability of archaeological site occurrence on any of the proposed tracts for leasing, BLM does not expect to recommend to the USGS Deputy Conservation Manager, Offshore Field Operations, that this stipulation be invoked on any tract in the proposed sale. However, if, at any time, a historically significant find, for example a shipwreck, is discovered on any of the leased tracts, this stipulation could be invoked (See Stipulation No. 1) so that measures would be taken to protect the shipwreck.

Stipulation No. 1

If the Deputy Conservation Manager, Offshore Field Operations (DCMOFO) having reason to believe that a site, structure or object of historical or archeological significance hereinafter referred to as "cultural resource", may exist in the lease area, gives the lessee written notice that the lessor is invoking the provisions of this stipulation, the lessee shall upon receipt of such notice comply with the following requirements:

Prior to any drilling activity of the construction or placement or any structure for exploration or development on the lease, including but not limited to, well drilling and pipeline and platform placement, hereinafter in this stipulation referred to as "operation", the lessee shall conduct remote sensing surveys to determine the potential existence of any cultural resource that may be affected by such operations. All data produced by such remote sensing surveys as well as other pertinent natural and cultural environmental data shall be examined by a qualified marine survey archeologist to determine if indications are present suggesting the existence of a cultural resource that may be adversely affected by any lease operation. A report of this survey and assessment prepared by the marine survey archeologist shall be submitted by the lessee to the DCMOFO and to the Manager, BLM OCS Office for review.

If such cultural resource indicators are present the lessee shall:

(1) locate the site of such operation so as not to affect adversely the identified location; or (2) establish, to the satisfaction of the DCMOFO on the basis of further archeological investigation conducted by a qualified marine survey archeologist or underwater archeologist using such survey equipment and technique as deemed necessary by the DCMOFO, either that such operation will not adversely affect the location identified or that the potential cultural resource suggested by the occurrence of the indicators does not exist.

A report of this investigation prepared by the marine survey archeologist shall be submitted to the DCMOFO and the Manager, BLM OCS Office for their review. Should the DCMOFO determine that the existence of a cultural resource which may be adversely affected by such operation is sufficiently established to warrant protection, the lessee shall take no action that may result in an adverse effect on such cultural resource until the DCMOFO has given directions as to its preservation.

The lessee agrees that if any site, structure, or object of historical or archeological significance should be discovered during the conduct of any operations on the leased area, he shall report immediately such findings to the DCMOFO, and make every reasonable effort to preserve and protect the cultural resource from damage until the DCMOFO has given directions as to its preservation.

Biological Resources Stipulation

Stipulation No. 2 covers the protection of biological resources. Inclusion of the biological resources stipulation would minimize the probability that a biological resource or habitat deserving protection would be adversely impacted by this lease proposal. The provisions of the stipulation ensure that if a lease tract is likely to include a biological resource or habitat deserving protection, measures will be taken to protect such resources or habitats. Also, since in enforcing the stipulation, the USGS Deputy Conservation Manager, Offshore Field Operations, may consider the recommendations of a Biological Task Force that could be composed of designated representatives of federal agencies and the affected states.

Stipulation No. 2

If biological populations or habitats which may require additional protection are identified by the DCMOFO in the leasing area, the DCMOFO will require the lessee to conduct environmental surveys or studies, including sampling, as approved by the DCMOFO, to determine existing environmental conditions, the extent and composition of biological populations or habitats, and the effects of proposed or existing operations on the populations or habitats which might require additional protective measures. The DCMOFO shall provide written notice to the lessee of his decision to require such surveys or studies. The nature and extent of any surveys or studies will be determined by the DCMOFO on a case-by-case basis.

Based on any surveys or studies which the DCMOFO may require of the lessee, the DCMOFO may require the lessee to: (1) relocate the site of operations so as not to affect adversely the significant biological populations or habitats deserving protection; or (2) modify operations in such a way as not to adversely affect the significant biological populations or habitats deserving protection; or (3) establish to the satisfaction of the DCMOFO that such operations will not adversely affect the significant biological populations or habitats deserving protection. Based on any surveys or studies which the DCMOFO may require of the lessee, the DCMOFO may also

require the lessee to provide for periodic sampling of environmental conditions during operations.

The lessee shall submit all data obtained in the course of such surveys or studies to the DCMOFO, with the locational information for drilling or other activity. The lessee may take no action that might result in any effect on the biological populations or habitats surveyed, until the DCMOFO provides written directions to the lessee, with regard to permissible actions.

In the event that important biological populations or habitats are identified subsequent to commencement of operations, the lessee shall make every reasonable effort to preserve and protect all biological populations and habitats within the lease area, until the DCMOFO provides written instructions to the lessee with regard to the biological populations or habitats identified. Operations, including siting, must be conducted as specified by the DCMOFO and so as to insure the protection and continued viability of the biological populations or habitats deserving protection in a manner consistent with the other purposes of the Outer Continental Shelf Lands Act, as amended.

Transportation Stipulation

Stipulation No. 3 covers the transportation of oil and gas resources to shore. Pipeline transportation is normally preferred for environmental reasons. Inclusion of the transportation stipulation will ensure the use of pipelines whenever the criteria set out in the stipulation are met.

Stipulation No. 3

Pipelines will be required, (1) if pipeline rights-of-way can be determined and obtained, (2) if laying such pipelines is technically feasible and environmentally preferable, and (3) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to any recommendation of the Intergovernmental Planning Program for Outer Continental Shelf Oil and Gas leasing, Transportation, and Related Facilities, with the participation of Federal and State governments, industry, and private interests. Where feasible and environmentally preferable, all pipelines, including both flow lines and gathering lines for oil and gas, shall be buried to a depth suitable for adequate protection from water currents, sand waves, storm scouring, fisheries trawling gear, and other factors as determined on a case-by-case basis. All valves, taps, or other irregular surfaces that might be vulnerable or might damage fishing gear will be buried to a minimum of one foot or to a

depth suitable for adequate protection or covered with an approved protective dome which will allow commercial trawl gear to pass over the structure without snagging or damaging the structure or fishing gear.

If, due to the criteria outlined above, pipelines are required then no hydrocarbon products will be transported by surface vessel from offshore production sites, except in the case of emergency following the completion of pipeline installation. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the DCMOFO. Where the three criteria set forth in the first sentence of this stipulation are not met and surface transportation must be employed, all vessels used for carrying hydrocarbons to shore from the leased area will conform with all applicable sections of Titles 33 and 46 of the U.S. Code and the regulations issued thereunder by the U.S. Coast Guard.

Drilling Muds and Cuttings Disposal Stipulation

Stipulation No. 4 covers the disposal of drill muds, cuttings and formation waters. Inclusion of this stipulation will ensure that all drill muds, cuttings, and formation waters are disposed of in a manner that would protect biological resources.

Stipulation No. 4

The DCMOFO may require the lessee to dispose of drill cuttings and drilling muds by shunting the material to a depth and location below the ocean surface as specified by the DCMOFO, or by transporting the material to disposal sites approved by the Environmental Protection Agency. The DCMOFO shall determine the method of disposal based upon review of the data obtained from the surveys and studies established pursuant to Stipulation No. 2, and from other relevant sources of information.

Based upon the composition of produced formation waters, the site-specific environmental conditions in a leasing area, and the data obtained from the surveys and studies established pursuant to stipulation No. 2, as well as data from other relevant sources, the DCMOFO may require the lessee to reinject formation waters. The DCMOFO shall provide written notice to th lessee of a decision to require reinjection of such formation waters.

Stipulation No. 5

The lessee shall include in his exploration and development plans submitted under 30 CFR 250.34 a proposed fisheries training program for review and approval by the DCMOFO pursuant to this stipulation. The training program shall be for the personnel involved in vessel operations (related to offshore exploration and development and production operations); and platform

and shorebased supervisors. The purpose of the training program shall be to familiarize persons working on the project of the value of the commercial fishing industry and the methods of offshore fishing operations and the potential hazards, conflicts and impacts resulting from offshore oil and gas activities. The program shall be formulated and implemented by qualified and experienced instructors in the kinds of fishing activities, methods of communication and navigational safety.

Military Area Stipulations

Stipulation No. 6 was requested by the Department of Defense and it would apply to 56 of the proposed tracts.

Stipulation No. 6

(To be included only in leases resulting from this sale for tracts 52-128, 52-143, 52-144, 52-158 through 52-161, 52-174 through 52-178, 52-188, 52-189, 52-191 through 52-195, 52-204 through 52-214, 52-431 through 52-444, 52-450 through 52-459, 52-476, 52-477).

(a) The lessee agrees that prior to operating or causing to be operated on its behalf boat or aircraft traffic into individual, designated warning areas, the lessee shall coordinate and comply with instructions from the Commanding officer, Fleet Area Control and Surveillance Facility, Virginia Capes Naval Air Station, Oceana, VA 23460. Such coordination and instructions will provide for positive control of boats and aircraft operating into the warning areas at all times.

(b) Whether or not compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee asumes all risks of damage or injury to persons or property, which occurs in, on, or above the Outer Continental Shelf, to any person or persons or to any property of any person or persons who are agents, employees or invitees of the lessee, its agents, independent contractors or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the Outer Continental Shelf, if such injury or damage to such person or property occurs by reason of the activities of any agency of the U.S. Government, its contractors, or subcontractors, or any of their officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the Commanding Officer, Fleet Area Control and Surveillance Facility, Virginia Capes Naval Air Station, Oceana, VA 23460, or other appropriate military agency.

Notwithstanding any limitations of the lessee's liability in Section 14 of the lease, the lessee assumes the risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States, its contractors or subcontractors, or any of

their officers, agents, or employees. The lessee further agrees to idemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the lessee, and to idemnify and save harmless the United Sates against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation and agencies, whether the same be caused in whole or in part by the negligence or fault of the United States, its contractors, or subcontractors, or any of their officers, agents, or employees and whether such claims might be sustained under theories of strict or absolute liability or otherwise.

(c) The lessee agrees to control his own electromagnetic emissions and those of his agents, employees, invitees, independent contractors or subcontractors emanating from individual, designated defense warning areas in accordance with requirements specified by the Commanding Officer, Fleet Area Control and Surveillance Facility, Virginia Capes Naval Air Station, Oceana, VA 23460, to the degree necessary to prevent damage to, or unacceptable interference with Department of Defense flight, testing, or operational activities conducted within individual designated warning areas. Necessary monitoring, control, and coordination with the lessee, his agents, employees, invitees, independent contractors or subcontractors will be effected by the commander of the appropriate onshore military installation conducting operations in the particular warning area provided, however, that control of such electromagnetic emissions shall permit at least one continuous channel of communication between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

Installation conducting operations in the particular warning area provided, however, that control of such electromagnetic emissions shall permit at least one continuous channel of communication between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

Geologic Hazards Stipulation

After completion of the geohazards study now underway, some tracts identified under Alternative No. 8 (see Section II.B.8) as being sites of possible sediment slumps could have a geohazards stipulation applied to them.

The proposed stipulation would prohibit the drilling of exploratory wells or the emplacement of seabed structures directly within the unstable portions of a lease block, unless the lessee can either prove to the satisfaction of the Deputy Conservation Manager that mass movement is unlikely or that should mass movement occur, the proposed structure or operation will not damage the environment.

Before drilling operations would be allowed within the unstable portions of a block, site-specific surveys would be required to evaluate the potential for mass sediment movement. This may require the lessee to survey areas outside of his block, because in most cases, portions of the slumped material

will lie outside of the lessee's block. For adequate evaluation of the slump body's potential for further movement, the entire body must be mapped and analyzed, not just the portion lying within the lessee's block.

By applying the stipulation to a block rather than deleting it, any potential petroleum resource located within the block can be successfully exploited. This could entail exploration or production of the resource through directional drilling techniques from either within or outside of the actual leased block.

Stipulation No. 7

Portions of this tract may be subject to unstable slopes or shallow faults, (mass movement of sediments). Exploratory drilling operations, emplacement of structures (platforms) or seafloor wellheads for production or storage of oil or gas, and the placement of pipelines will not be allowed within the potentially unstable portions of this lease block unless or until the lessee has demonstrated to the Deputy Conservation Manager's satisfaction that mass movement of sediment is unlikely or that exploratory drilling operations, structures (platforms), casing, wellheads, and pipelines can be safely designed to protect the environment in case such mass movement occurs at the proposed location. This may necessitate that all exploration for and development of oil or gas be performed from locations outside of the area of unstable sediments, either within or outside of this lease block.

If exploratory drilling operations are allowed, site-specific surveys shall be conducted to determine the potential for unstable bottom conditions. The extension of these surveys may be required outside of the leased block. If placement of structures (platforms) or seafloor wellheads for production or storage of oil or gas are allowed, all such unstable areas must be mapped. The Deputy Conservation Manager, Offshore Field Operations also may require soil testing before exploration and production operations are allowed.

Undetonated Explosives Stipulation

Stipulation No. 8 covers the detection of undetonated explosives. Although the USGS has authority to require a lessee to do additional pre-drilling surveys to detect explosives, it would rely on BLM to identify which tracts might need these additional surveys. Therefore based on further consultation with the U.S., Environmental Protection Agency (EPA), BLM will determine which tracts will be subject to the stipulation, which will minimize the probability that any undetonated explosives would adversely affect drilling activities.

Stipulation No. 8

If the Deputy Conservation Manager, Offshore Field Operations (DCMOFO) believes any undetonated explosives may exist in a leased tract, the lessee shall conduct surveys as specified by the DCMOFO to determine the

location of any undetonated explosives. Upon completion of any such surveys, the lessee shall forward a report and all pertinent data to the DCMOFO for review. Should the DCMOFO determine that the existence of such devices may adversely affect any activity or operation, such as the construction or placement of any structure for exploration or development on the lease, the lessee shall take no action until DCMOFO has given directions as to the conduct of that operation.

2. Alternative 2: Delay the Sale

a. Description

An alternative mentioned frequently during the scoping process was delaying the sale so that information obtained as a result of exploration on tracts leased in Sale No. 42 would be available before further drilling could take place. A delay was mentioned as desirable in order to provide information on the hydrocarbon potential and the effects of exploratory activities on the biological resources of the area. This was mentioned also to further the intent of Section 102(2)(B) of the OCS Lands Act, as amended, which states that one of the purposes of the Act is "to balance orderly energy resource development with protection of the human, marine, and coastal environments,...".

As currently scheduled, proposed Sale No. 52 would take place in October, 1982. Under the proposed revision of the schedule, it would be moved up to August, 1982. Initial exploratory drilling on Sale No. 42 leases started on July 24, 1981. Tracts tentatively scheduled for proposed Sale No. 52 cover a wide area, extending beyond those leased in Sale No. 42 to areas with different geological and physical oceanographic characteristics and with varying biological resources. Thus, a reasonable alternative for delaying the sale does not uniformly apply to all the tracts in the proposed Sale. Different possible reasons for delay apply to different portions of the lease area.

For those tracts in less than 200 meters of water, a delay could be considered in order to assess the results of the Georges Bank monitoring program. Initial samples for this program were taken in July, 1981. Thus, preliminary results will be available before the proposed Sale is held. However, there are no existing leases or sampling sites beyond 200 meters. It would be inappropriate to extrapolate any results from the monitoring program on Sale No. 42 leases to tracts proposed for leasing beyond 200 meters due to different physical oceanographic processes and biological resources at the greater depths. In addition, the hydrocarbon potential of tracts beyond 200 meters could not be inferred from tracts in water depths less than 200 meters because the geological formations differ. Thus, if a delay of the sale were considered desirable to assess the results of drilling on Sale No. 42 leases, it would only be meaningful for those tracts in water depths shallower than 200 meters. Therefore, such a delay would roughly leave a sale with the configuration of Alternative 5, in which tracts in less than 200 meters of water are proposed for deletion to protect fisheries and other biological resources.

Other studies will provide additional information prior to the proposed sale without a delay. These include BLM-funded projects such as the Cetacean and Turtle Assessment Program study which will provide information on population size, distribution, and habitat characteristics; studies on oil and sound effects on cetaceans, and the ongoing Canyon Processes study. This last, which is a 3-year effort, will have interim results available prior to the proposed Sale. In addition, the Exxon-sponsored Toms Canyon monitoring program in the Mid-Atlantic should have results available by the end of 1981.

For those tracts in greater water depths, another reason for delay has been proposed by NOAA. NOAA feels that before deepwater drilling proceeds in an area of high biological productivity and commercial fishery value, such as that being considered for proposed Sale No. 52, that industry and government should gain practical operating experience in the techniques and limitations of deepwater drilling (1/28/81 letter commenting on the proposed Sale No. 59 DEIS). Thus, NOAA feels that it would be appropriate to allow an additional year before holding proposed Sale No. 52 to allow time for exploratory activities in the offshore reef complex of the deep-water tracts of proposed Sale No. 59 in the Mid-Atlantic (5/22/80 letter in response to Call for Nominations and Comments). Proposed Sale No. 59 is tentatively scheduled for December, 1981. Initial exploration on tracts that may be leased is projected sometime in 1982. If such a rationale were deemed desirable, it would apply only to those tracts in water depths beyond some cutoff, such as 2000 feet, so that a delay of offering all the tracts in the proposed sale for this reason would not logically follow such a decision. In addition, delaying the Sale may allow time for a possible marine sanctuary designation of the Georges Bank area.

b. Summary of Environmental Consequences

A decision to delay the sale would result in a subsequent delay in the exploration, and production of oil and gas resources, estimated to be 1.73 billion barrels of oil and 5.25 trillion cubic feet of gas for conditional mean. Any economic or national security benefits which could be attributed to the domestic production of hydrocarbons in these amounts would thus be postponed.

A delay of the sale is not likely to result in any environmental consequences different than those projected as a result of Alternative 1. Impacts would occur at a later period of time, but would probably not vary in nature or degree.

3. Alternative 3: Cancel the Sale

a. Description

This alternative equals no action. If this should occur, it will not preclude all oil and gas activity on the North Atlantic OCS as exploration will continue on Sale 42 blocks, and, if a commercial discovery is made, development and production operations would take place. In addition, if the proposed Sale was cancelled for any reason, the blocks included in it could be renominated for a later sale. Nevertheless if this Sale were cancelled, the impacts expected would be as follows.

b. Summary of Environmental Consequences

Cancelling the proposed Sale will eliminate impacts expected to result from the proposal as described under Alternative 1, but not all impacts from oil and gas activity in the North Atlantic region. Realization of economic or national security benefits resulting from the estimated 1.73 billion barrels of oil and 5.25 trillion cubic feet of gas would be foregone.

All impacts related to oil spills from the proposal would be eliminated, but the continued importation of oil at present levels, and the tankering of both foreign and domestic crude oil and refined products is expected to result in 93 spills greater than 1000 barrels over the next 30 years in the North and Mid-Atlantic region. Impacts from these sources would be expected to continue.

Impacts to air quality that may have occurred onshore as a result of facilities resulting from the proposed Sale would not occur, but the use of some alternate energy sources may cause other air pollution problems. For example, if there were a greater use of coal in the North and Mid-Atlantic regions, significant air pollution control problems could be encountered.

Cancelling the proposed Sale would eliminate all increases in economic activity expected to occur as a result of the Sale. Although the jobs that would be foregone if the sale were cancelled are not a very significant number on a regional basis, the expected increases in employment levels in or near directly affected counties that will be foregone represent significant losses to some local economies (See Section IV.C.13). However, possible adverse impacts to local communities associated with the accompanying population growth would not occur.

4. Alternative 4: Modify the Proposal by Deleting 49 Blocks in Water Depths Greater than 2000 meters. (6256 ft).

a. Description

This alternative is presented based on the fact that equipment and technology for OCS deep water hydrocarbon production has yet to develop.

Technology is presently available for the petroleum industry to explore, develop, and produce oil and gas in water depths to 2000 feet. Beyond this depth, additional experience and/or extensive modifications to existing or recently designed equipment will be needed to achieve full production capabilities.

The limits of exploration technology have increased dramatically over the last five years. The deepest exploratory well to date was drilled in 1979 by the drillship "Discoverer Seven Seas" in approximately 5000 feet of water off the coast of Newfoundland. Semi-submersibles, such as the Sedco 709, are claimed to be able to drill in water depths up to 8000 feet. This unit recently drilled a well in 4000 feet of water off Eastern Canada. No serious complications have arisen with any recent deepwater exploratory operations.

Major advances in positioning and re-entry techniques have been the major factors in deepwater exploration. Dynamic positioning, a positioning and stabilizing system utilizing thrust provided by propulsion units, allows deepwater facilities to maintain drilling position without the aid of anchors. Guidelineless re-entry utilizes subsea acoustical and television equipment to guide the drill string into a wellhead funnel thousands of feet below the surface of the water.

These technologically advanced systems, incorporated into drilling rigs such as the drillships and semisubmersibles previously mentioned will enable the petroleum industry to explore most of the tracts selected for environmental study for proposed Sale No. 52. Since the proposed sale area includes tracts as deep as 9285 ft, there are some tracts possibly incapable of even presently being explored. Only a drilling vessel such as Global Marine's drillship Glomar Explorer is presently equipped to operate at depths exceeding 8000 ft. However, it seems unlikely that a drillship would be able to operate successfully in the relatively rough waters of the North Atlantic without having considerable periods of down-time.

Production capabilities generally run some eight years behind exploration technology.

The deepest production facility currently in place is Shell's Cognac Platform in 1025 feet of water in the Gulf of Mexico. However, platforms have been designed for operation in depths of approximately 2000 feet. Exxon Production Research Company has been the main force behind the development of the guyed tower. The basic design calls for a tower, supported on a bullet-nosed foundation, held upright by guylines. A ten month study of a tower designed for 1500 feet of water and North Sea wind and wave conditions showed that the facility had adequate strength to with-stand 100 foot waves and that the structure could be fabricated and installed using existing equipment and procedures. Exxon has plans to install a guyed tower in the Gulf of Mexico at a depth of 1200 feet and believes the design is applicable to depths of 2000 feet.

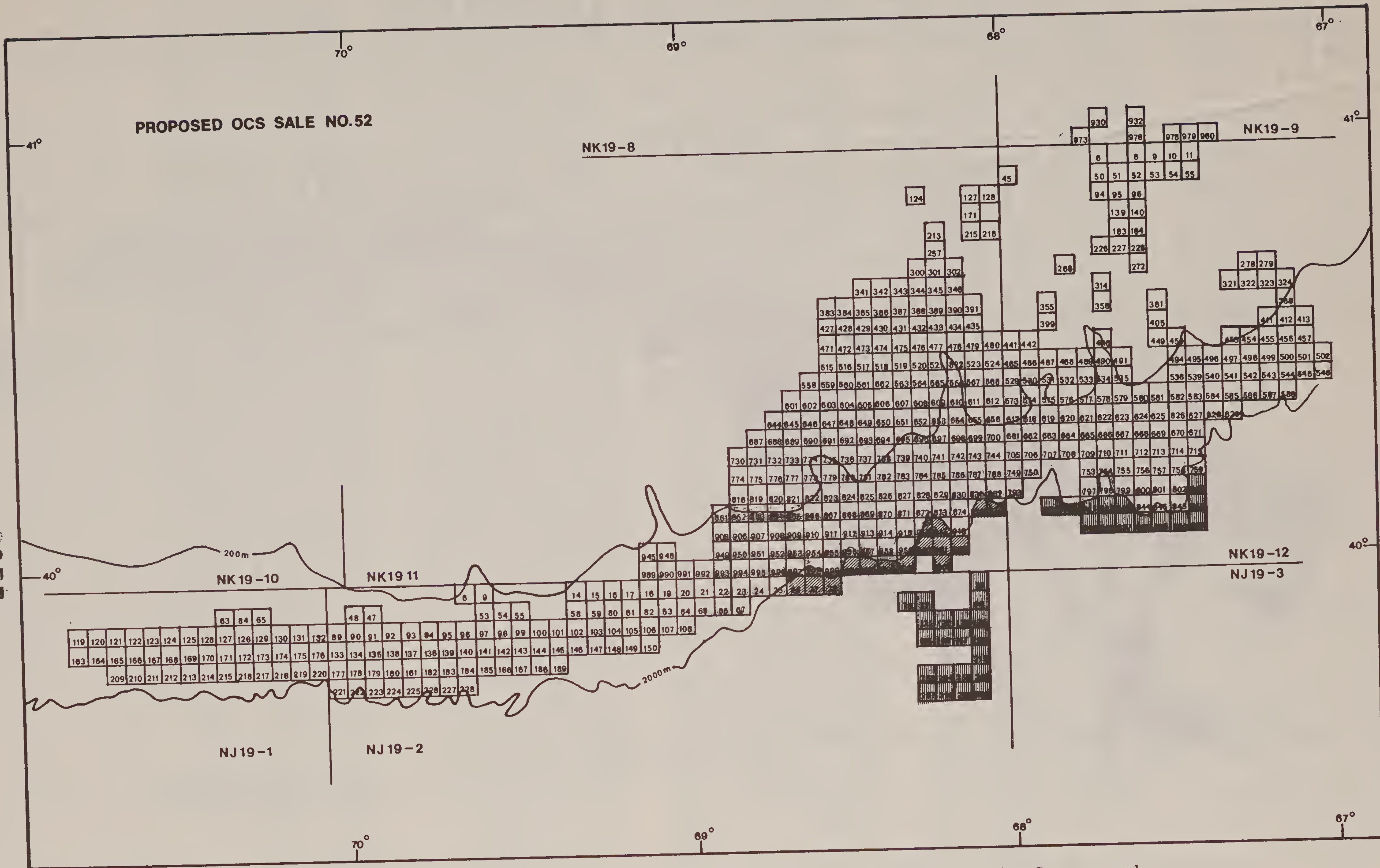

Figure II.B.4-1. Alternative 4: Modify the Proposal by Deleting Tracts in Water Depths Greater than 2000 meter. Shaded Tracts are those Considered for Deletion.

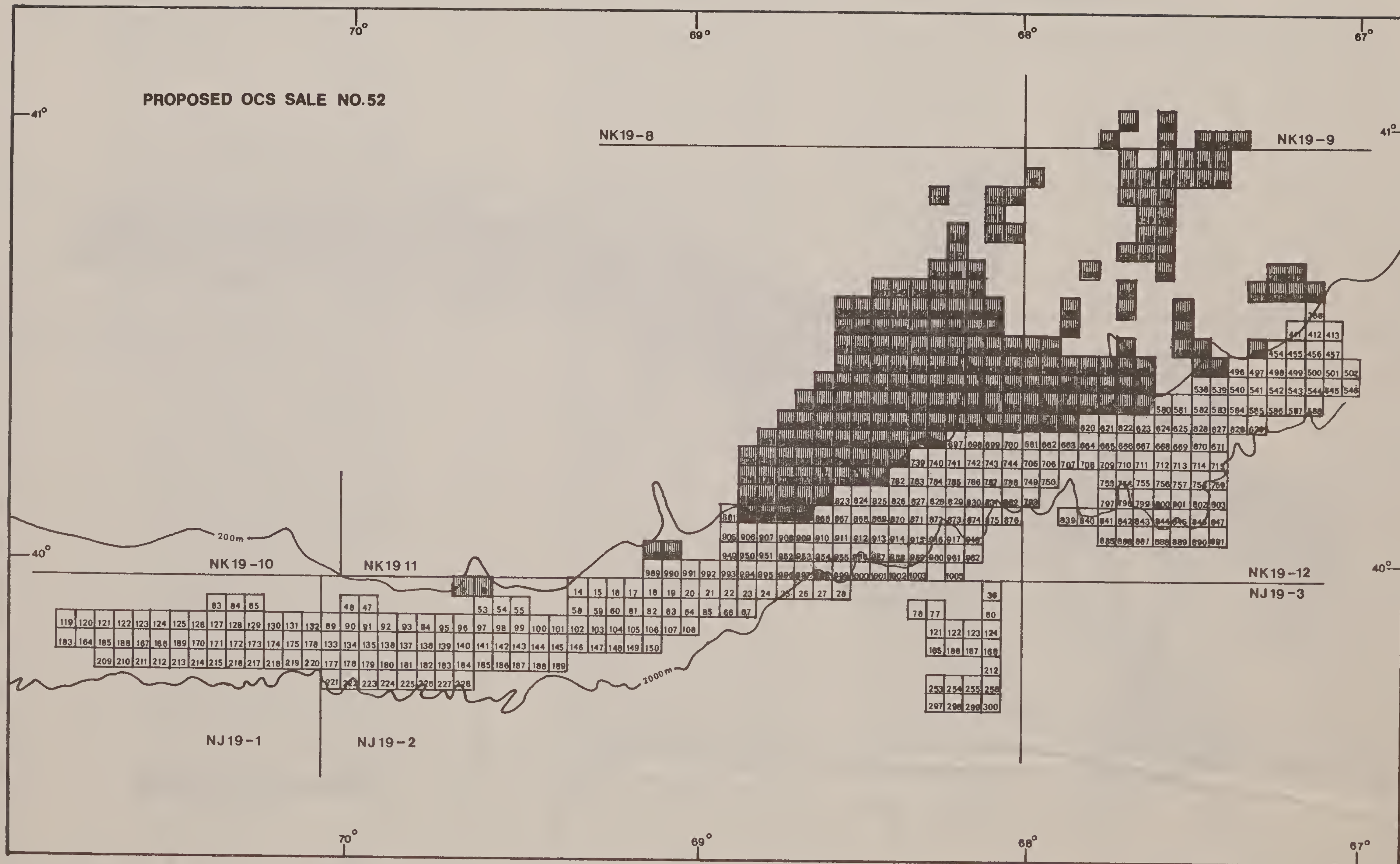

Figure II.B.5-1. Alternative 5: Modify the Proposal by Deleting Tracts to Protect Fisheries and Other Biological Resources. Shaded Tracts are those Considered for Deletion.

Conoco has pioneered the design of the tension leg platform (TLP). The TLP is essentially a semi-submersible, given additional support by tensioning cables extending from the platform to templates anchored on the sea-bottom. The present design will allow placement of the TLP in water depths up to 2000 ft. Conoco engineers are confident that with additional experience and engineering, the TLP concept should be adequate for operation in water depths as great as 6000 ft. Conoco presently has plans to install a TLP in 482 feet of water in their Hutton Field in the North Sea.

Deepwater production may also be undertaken through the installation of subsea completion/production systems. Theoretically, the satellite well system, a completion network composed of a single tree originating from a single well and connected by flowlines to a remote facility, can be installed at any depth. Actual operating satellite well systems are presently in place at depths of about 500 feet. Petrobras has ordered a single completion system reportedly capable of operating at 900 foot depths. Mobil Oil claims that one of their systems has proven capabilities of 4000 feet or greater. Exxon Production Research Co. believes their Subsea Production System (SPS) is capable of operating in depths of 6000 feet or more.

Advances in the placement of pipelines has been rapid. Saipem Company's Castoro Sei recently laid a 20 inch pipeline in 2000 feet of water in the Sicilian Channel. The Castoro Sei is basically a semisubmersible, equipped with dynamic positioning systems, capable of operating as a lay barge. Plans for the laying of another line across the same route are underway. The Castoro Sei layed an average of 1.5 km (.932 miles) of pipeline daily (with a high of 2.5 kilometers/day (1.55 miles/day) in seas as high as 20 feet. Saipem officials privately are confident that the vessel can lay pipe to depths of 6000 to 7000 ft.

Recent projection figures for the proposed sale area predict exploration will begin about 1984. Present exploration technology seems capable of operating in depths up to 8000 ft. Beyond this depth modifications to existing equipment may be needed to explore fully the deepest tracts in the proposed sale area. A limiting factor may be the apparent unsuitability of drillships to economically operate within the rough waters of the North Atlantic. Semisubmersibles seem to be the logical operational choice, however none presently exist which are capable of operation in waters exceeding 8000 ft. in depth.

Development is expected to begin in the sale area about 1985 and production will begin about 1995. It is possible that technology will not be available to develop and produce from these blocks exceeding approximately 2000m (6256 ft) in water depth. Due to the lack of incentive caused by disappointing results from deepwater exploratory drilling, development of technology to produce in extremely deep areas on the continental slope and rise has not been extensively undertaken. If substantial amounts of oil and gas are found, it is likely that the technology will be developed.

The 49 blocks being considered for deletion under this alternative are shown in Figure II.B.4-1. Implementing this alternative would leave 491 blocks in the proposed Sale.

b. Summary of Environmental Consequences

This alternative would result in a 9% reduction in the proposed sale area. A proportionate decrease in the amount of recoverable hydrocarbons can be expected.

Impacts on water and air quality, sensitive coastal areas, endangered birds and coastal species and coastal recreation resources are expected to remain the same as those for Alternative 1. Conflicts with military activities would not significantly decrease.
The small reduction in the sale area would not significantly reduce the expected socioeconomic impacts.

The deletion of these tracts would result in a reduction in the number of estimated spills (10 estimated spills under Alternative No. 1 versus 9 under Alternative No. 4). Potential impacts to endangered turtles and marine mammals and pelagic birds and other coastal waterbird colonies would, therefore, be reduced. Potential land use conflicts would also be reduced as the reduction in expected recoverable hydrocarbon resources would result in a reduction in the size of future processing plknt size.

5. Alternative 5: Modify the Proposal by Deleting 205 Blocks to Protect Fisheries and Other Biologickl Resources

a. Description

Under this alternative, 205 tracts (see Figure II.B.5-1) located on the shelf, and canyon head areas along the southern edge of Georges Bank within the proposed Sale area would be deleted. These tracts are within the area of commercially important fishing grounds. If such areas are leased and explored, some acreage would be lost to commercial fishermen. Therefore, maneuverability of fishing vessels would be impaired and fishing vessels would be required to haul nets each time a platform is encountered.

Fishing activity within the proposed Sale area is concentrated on the shelf and along the shelf break; the proposed deletions would greatly reduce the potential for conflict in this area. Deletion of these blocks would minimize interference with the commercial fisheries and offer protection for a variety of species which include yellowtail flounder, hake, lobster, and red crab (See Visual No. 5).

The 205 tracts being considered for deletion under this alternative would leave 335 tracts in the proposed Sale located in areas relatively unimportant to the demestic fishing industry. Foreign fishing, however does take place in the area of remaining under this alternative.

b. Summary of Environmental Consequences

Under this Alternative, the impacts to domestic fisheries due to OCS activities would be greately reduced. Sixty-nine fewer production wells and 7 fewer platforms would be expected, with 248,262 less barrels of drilling muds being discharged in the proposed Sale Shelf Area. Impacts to commercial fisheries due to rigs and platforms would be virtually eliminated. Some adverse impacts to the foreign fisheries would be expected due to spacial loss. The possibility of adverse effects caused by spilled oil on recreation and coastal fisheries would also be reduced. There would be a substantial reduction in the amount of pollutants entering the offshore atmosphere. Elimination of impacts on water quality within the 200-meter isobath, as described under Alternative 1. Porbability of an oil spill impacting any endangered species or their habitat would be reduced.

6. Alternative 6: Modify the Proposal by Deleting 33 Tracts At or Near the Heads of Canyons

a. Description

The thirty-three tracts proposed for deletion in this alternative lie at or near the heads of Powell, Lydonia, Hydrographer, Oceanographer, Welker, Gilbert and Veatch Canyons in water depths from 160 to 825 m (see Figure II.B.6-1). These areas are important trap/pot areas for lobster and longline areas for tilefish. These tracts are also included in the 205 tracts considered for deletion in Alternative 5.

Impact on canyon areas because they are important habitat for lobster and tilefish was an issue identified during the scoping process for proposed Sale No. 52.

b. Summary of Environmental Consequences

This alternative would largely eliminate potential impacts to biological resources. All of the specific resources in all these canyons are unknown, but canyons in the North Atlantic are known to be important habitats for lobster, coral and tilefish. The offshore lobster population occurs along the upper slope and outer continental shelf at depths roughly of 110 to 450 m with highest concentrations in canyon heads (Cooper and Uzmann, 1977). Wigley et. al. (1975) reporting on the results of the NMFS quantitative surveys on eastern Georges Bank at depths from 229 to 1,64m., stated:

"..red crabs were common from offshore Maryland to western Georges Bank, but rather sparse in the Georges Bank region. Bathymetrically, red crabs were scarce in relatively shallow waters, most common at intermediate depths, and moderately sparse to absent in deep water." It appears the lease area is not of great importance to the fishery and will not be in the future. Possible impacts to the benthic environment in canyons due to direct impacts from drilling muds and cuttings would be eliminated.

Impacts to pelagic birds might be reduced somewhat under this alternative over those expected under Alternative 1, since pelagic birds are known to congregate at the heads of canyons.

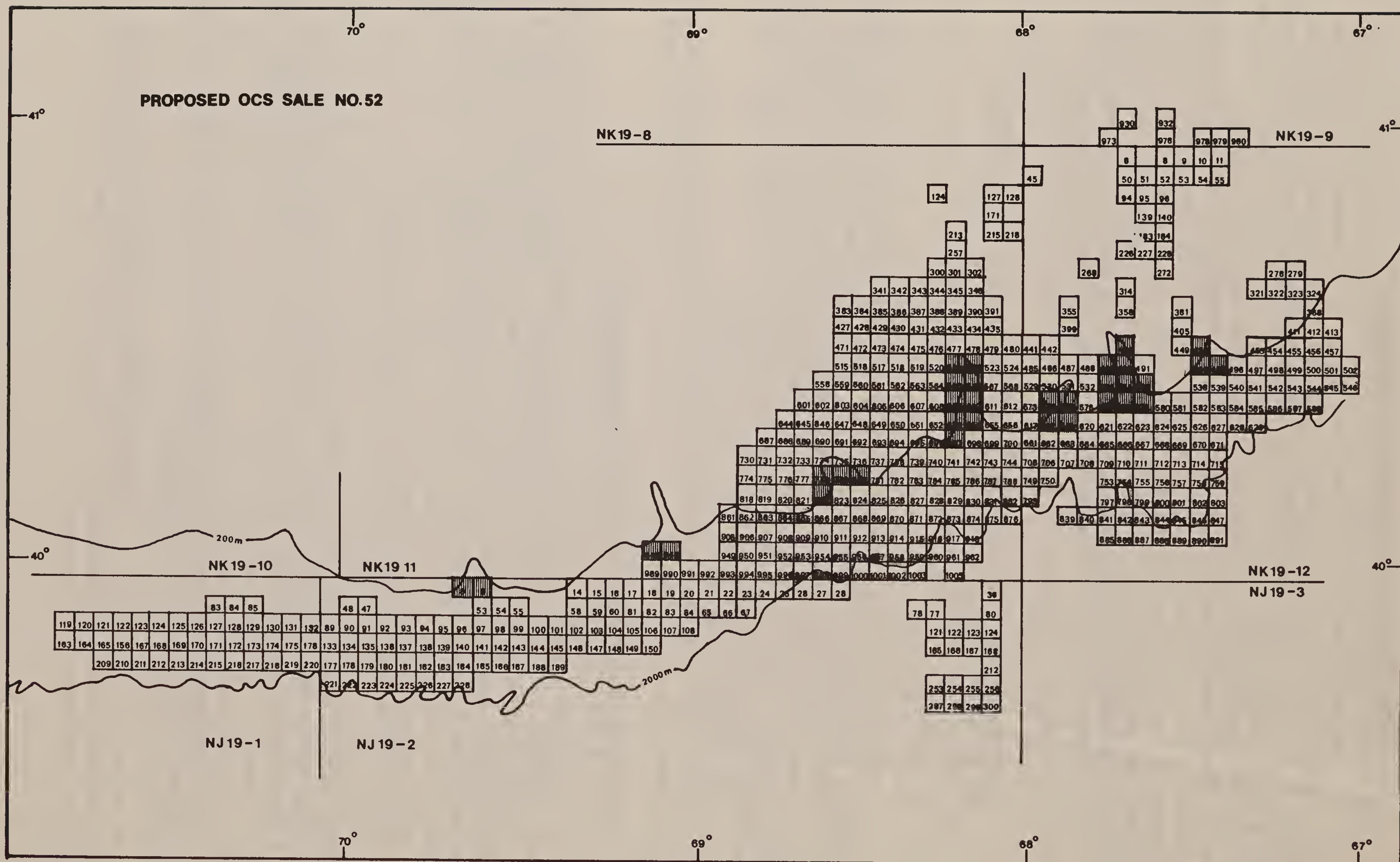

Figure II.B.6-1. Alternative 6: Modify the Proposal by Deleting 33 Tracts at or Near the Heads of Canyons. Shaded Tracts are those Considered for Deletion.

Any onshore impact(s) associated with transportation of resources is not expected to be significantly different from those identified under Alternative 1.

7. Alternative 7: A Georges Bank Marine Sanctuary

On May 10, 1979, the Conservation Law Foundation (CLF) of New England submitted a formal nomination of Georges Bank as a marine sanctuary. The purpose of the nomination was to protect the fishery resources and the fishing industry on Georges Bank from non-fishing activities which would not be compatible with this purpose. The nomination would specifically prohibit the dumping of toxic materials although other activities such as oil and gas development would not be prohibited, but would be managed consistent with the goals of the sanctuary.

Currently, there are no active candidates for Marine Sanctuaries in the North Atlantic. The Georges Bank nomination remains on the List of Recommended Areas (LRA). Under the terms of the settlement agreement for the litigation pertaining to Lease Sale No. 42 (Conservation Law Foundation v. Andrus, 13, ERC 1865), NOAA is required to evaluate available information on Georges Bank by December 1, 1981 to determine whether all or parts of the area should be placed on the List of Active Candidates. The Secretary of the Interior does not have the authority to designate a marine sanctuary. The following analysis examines a hypothetical marine sanctuary over the Georges Bank as it might be configured based on this history and our assumption of its possible operation.

a. Description

A Georges Bank Sanctuary could be established to protect the fishery encompassing approximately 20,000 square miles of intensive fishing grounds off the coast of Massachusetts. The Sanctuary could include all water within the 200-meter contour east of 69 10' longitude, and bounded by the Great South Channel, the Northeast Channel, and the heads of Powell, Lydonia, Hydrographer, Oceanographer, Welker, Gilbert and Veatch canyons. It could encompass 205 tracts, indetical to those in Alternative 5 of the proposed Sale (see Figure II.B.5-1) within areas important to commercial fishing: yellowtail flounder, cod, haddock, hake and lobster. The boundary of the hypothetical sanctuary is shown in Figure II.B.7-1.

Human activities, including oil and gas development, might be allowed within sanctuaries to the extent that such activities do not have significant effect on the resource value of the sanctuary. However, since no actual sanctuary or plan exists, the alternative here assumes oil/gas development as regulated under the conditions described below and the sale would be held as proposed except that the 205 tracts would be leased with the conditions to accommodate the possible sanctuary.

Considered Restrictions Within Sanctuary Boundaries

In order to protect the fishery resources of Georges Bank, the following regulations could be imposed within the sanctuary to the extent necessary to ensure the protection of the marine environment.

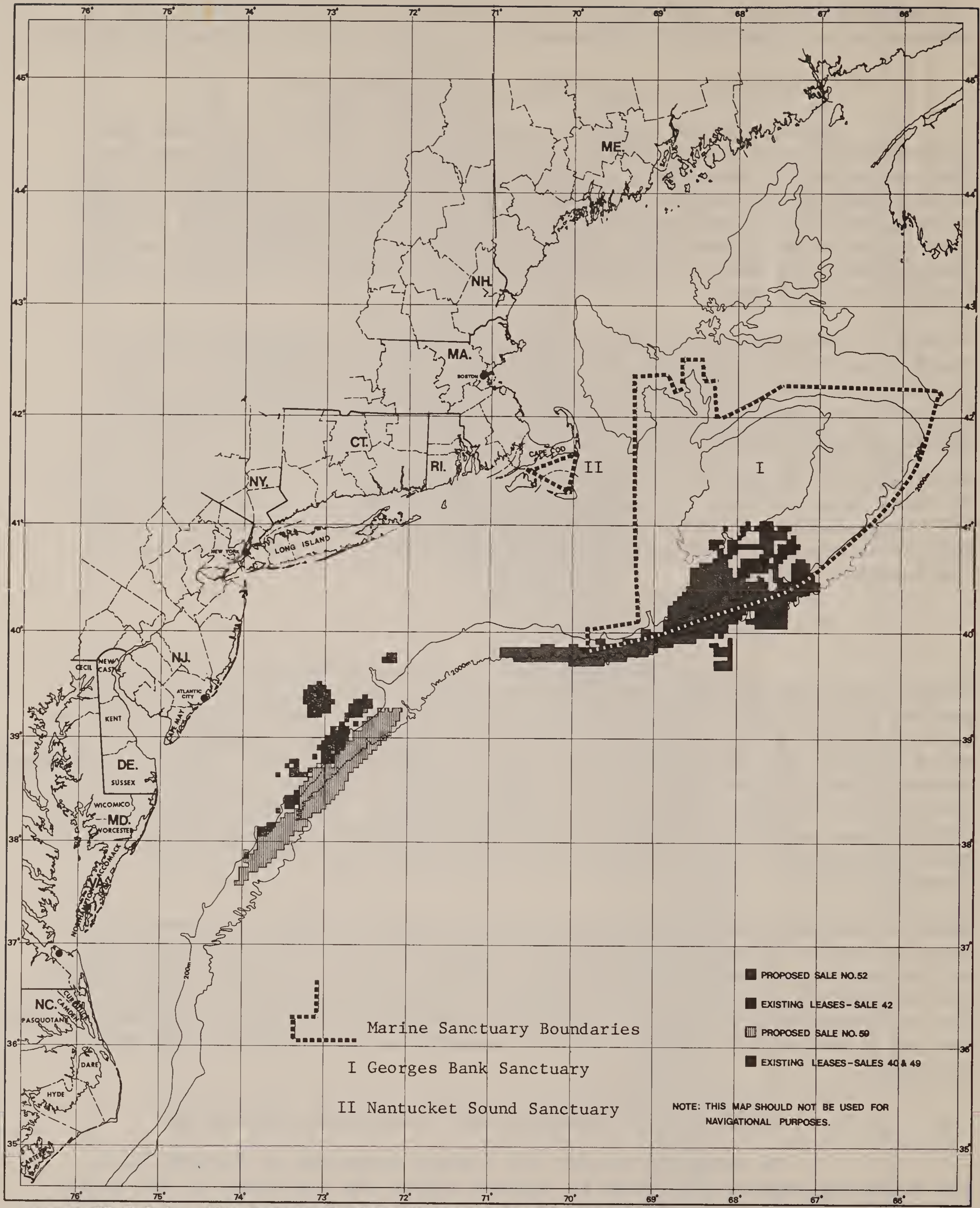

Figure II.B.7-1. Alternative 7: Considering Marine Sanctuaries.

1. Require the barging of drilling muds and cuttings near canyon heads. Thirty-three tracts lie at or near the head of Powell, Lydonia, Hydrographer, Oceanographer, Welker, Gilbert and Veatch canyons in water depths from 160- to 825m (see Figure II.B.6-1). These are important trap/pot areas for lobster and longline areas for tilefish.

2. Control discharges in the 205 tracts of the proposed Sale that are within the sanctuary boundaries as required under EPA NPDES permits for Sale No. 42 on Georges Bank. These restrictions include that discharges be pre-mixed with sea water at a 10:1 ratio, and that the discharge does not exceed a maximum rate of 30 barrels per hour. The objective is to dilute the discharge prior to entering the water column and keeping the discharge below the maximum concentration of eggs and larvae in the water column.

3. Require pipelining of oil to a moored buoy outside the sanctuary and tankering to existing refineries in the Mid-Atlantic and Gulf of Mexico to protect the integrity of the sanctuary. Statford is the northernmost field to be developed in the North Sea. The weather consists of sustained periods of high winds and accompanying high seas as well as reduced visibility with snow and icy conditions in the winter. An offloading buoy system has been used since 1978, designed to accommodate 150,000 DWT vessels. The tankers are allowed to connect in up to 23-ft significant wave heights and loading has continued in up to 30-ft significant wave heights (Bjorn Bache, Exxon Corporation, public hearing on the Draft Supplemental Environmental Impact Statement for OCS Sale No. 42).

4. Restrictions on commercial fishing in the North Atlantic, which includes the proposed sanctuary boundaries. This would be regulated by the New England Fishery Management Council under the Fishery Conservation and Management Act.

5. Hydrocarbon operations under existing lesses may continue subject to all conditions imposed by various Federal authorities.

b. Summary of Environmental Consequences

Required barging near canyon heads would protect populations of lobster and tilefish from any possible direct impact associated with drill muds and cuttings. Increased suspended sediments due to drilling muds and cuttings can damage coral populations by covering rocks, fouling the colonies, or abrading their tissues. This damage would be virtually eliminated by this alternative. Barging would reduce the amount of materials that could be transported to deeper canyon areas. Control discharges in 205 tracts would improve water quality and decrease any possible impact on phyto-, zoo-, and ichthyoplankton and ultimately to the commercial fisheries on Georges Bank. Pipelining of oil to a moored buoy outside the sanctuary would increase protection from chronic discharges associated with on-loading of tankers within the sanctuary.

8. Alternative 8: Modify the Proposal by Deleting 94 Tracts Containing Possible Sediment Slumps

a. Description

The 94 tracts listed below have been identified as sites of possible sediment slumps. Identification was made by interpolating from information provided by U.S. Geological Survey. The data consists of preliminary interpretations of widely spaced (10 km) tracklines oriented normal to the bathymetric contours reported on by Aaron and others (1980). A preliminary analysis of seismic information collected within the proposed sale area by O'Leary and Twichell (1981) was also utilized.

A complete discussion of sediment slumping within the lease area may be found in Section IV.B.1. Aaron and others (1980) have pointed out that slump features are difficult to identify unequivocally in isolated, widely spaced seismic tracklines run normal to the bottom contours. In addition, Robb, Hampson and Twichell (1981) note that the continental slope of the Atlantic Continental Margin appears to be extremely complex in morphology, being composed of valleys and gullies of various trends. Unconformities

having overlying sedimentation can easily create the appearance of allocthonous masses emplaced on the continental slope, if the surface is viewed in two-dimensional cross section on isolated seismic profiles. Thus, features identified in isolated profiles as slump masses may in fact be stable, topographic structures.

USGS is now in the process of interpreting more closely spaced seismic profiles of the proposed Sale area. In addition, profiles parallel to the bathymetric contours have been collected. Long-range and mid-range side scan sonar data will aid in interpretation.

Preliminary interpretations indicate that slumping may be prevalent on the lower slope and upper rise regions of the proposed sale area (See Section IV.B.1). The list of tracts being considered under this alternative is subject to change pending the completion of the more detailed tract-specific geohazards analysis. This information will be available in time for the EIS. At that time, USGS will recommend that either certain tracts be proposed for deletion or that geological stipulations be placed on tracts subject to mass sediment movement.

Should the tracts listed below be sites of sediment slumps, damage to exploratory and producing wells, or structural damage to platforms or other seafloor systems is possible should mass movement of sediment occur. Such damage could result in oil or gas blowouts or oil spills, with associated environmental impacts.

The tracts being considered for deletion (figure II.B.8-1) under this alternative are:

NJ 19-1

125
126
131
1
69
170
175
213
214

NJ 19-2

22	65	186
23	66	
24	67	
25	105	
26	106	
27	107	
28	108	
62	142	
63	149	
64	150	

NK 19-11

913	997
953	998

954	999
955	1000
956	1001
957	
994	
995	
996	

19-12

501	624	714	802	889
502	627	715	803	890
543	628	754	839	891
544	629	755	842	
545	667	756	843	
546	668	757	844	
583	669	758	845	
584	670	759	846	
585	671	798	847	
586	711	799	886	
587	712	800	887	
588	713	801	888	

Deletion of these 94 tracts would leave 446 tracts for sale.

b. Summary of Environmental Consequences

Implementation of this Alternative would result in an 18% reduction of the proposed Sale area. Deletion of the 94 tracts would reduce the total amount of expected recoverable hydrocarbons. Thus, the probability of an oil spill occurring could also be reduced. Consequently, expected impacts on sensitive coastal habitats, endangered birds and coastal species, and pelagic birds could be moderately reduced.

Impacts on air quality, water quality, coastal recreation resources and socioeconomic factors are expected to remain the same as for those under Alternative 1.

Should the tracts listed actually be sites of sediment slumps, implementation of the deletion alternative could reduce the potential danger of structural damage and/or collapse of platforms or other seafloor systems which may have been placed within the tracts.

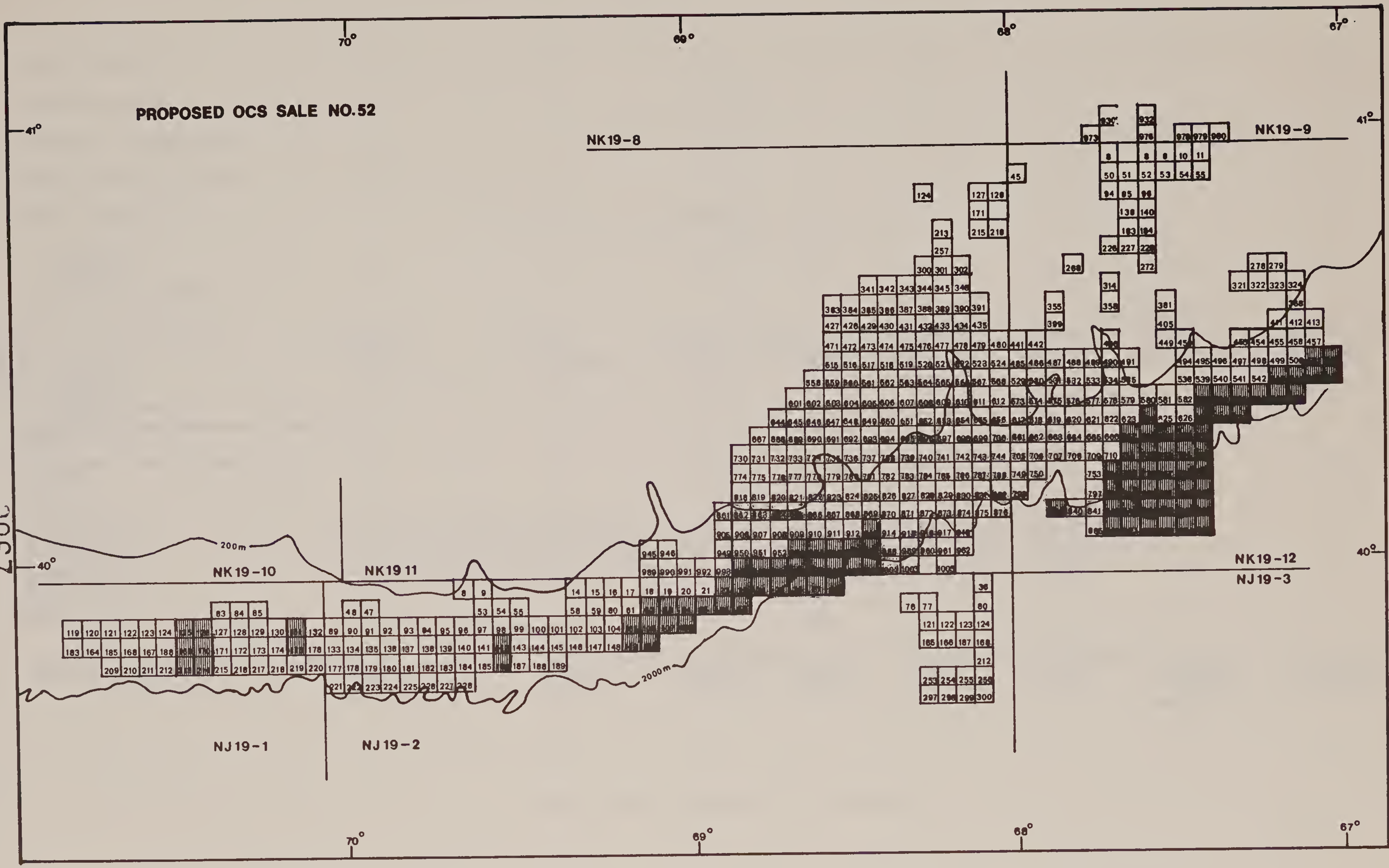

Figure II.B.8-1. Alternative 8: Modify the Proposal by Deleting 94 Tracts Containing Possible Sediment Slumps. Shaded Tracts are those Considered for Deletion.

Table II.B.9. Comparison of Alternatives

Areas of Concern	1 Proposed Action	2 Delay the Sale	3 Cancel the Sale	4 2000 m. Deletion	5 Fisheries Deletion	6 Canyon Deletion	7 Marine Sanctuary Deletion	8 Geohazards Deletion
Air Quality	1	1	0	1	1	1	1	1
Water Quality	1-2	1	0	1	1	1	1	1
Plankton	1	1	0	1	1	1	1	1
Benthos	2	2	0	2	1	1	1	1
Sensitive Coastal Areas	2	2	0	2	2	2		2
Endangered and Threatened Species								
Coastal Species	1	1	0	1	1	1		1
Turtles	2	2	0	2	2	2	2	2
Whales	2	2	0	2	2	2		2
Birds (Non-Endangered)	3	3	0	3	2	2		3
Commercial Fisheries								
Finfish	2	2	0	2	1	2	2	0
Shellfish								
Sport Fisheries	1	1	0	0	0	0	1	0
Land Use Plans/Policies	2	1	0	1	1	1	1	1
Recreation and Tourism	2	2	0	2	2	2	2	2
Regional Economy	1	1	0	1	1	1	0-1	1
Local Economies	2	2	0	2	1-2	2	0-2	1-2

Table II.B.9. Comparison of Alternatives

Areas of Concern	1 Proposed Action	2 Delay the Sale	3 Cancel the Sale	4 2000 m. Deletion	5 Fisheries Deletion	6 Canyon Deletion	7 Marine Sanctuary Deletion	8 Geohazards Deletion
Military Uses	3	3	0	3	3	3	3	3
Navigation	1	1	0	1	1	1	1	1
Geohazards	2	2	0	2	2	2	2	1

Degree of Impact	
Major	3
Moderate	2
Minor	1
None	0

*The major geohazards associated with the slope tracts for this proposed sale is mass movement of sediment which, should it occur, could have a major impact. However, data at this time are inconclusive as to the occurrence of mass sediment movement (see Sect. IV.B.1).

Section 3

Description Of The Affected Environment

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. Physical Environment

1. Geology

a. Upland

The North American Continental Margin to the west of the Proposed Sale area is composed of the Atlantic Coastal Plain, Appalachian Mountains, and New England Maritime physiographic subdivisions. The Appalachian highlands are comprised of four provinces and contain crystalline Precambrian, Paleozoic and Triassic rocks. The New England Maritimes region extends northeastward from New York State to Newfoundland and consists of several provinces of diverse age and rock types. The emerged portion of the Atlantic Coastal Plain lies to the east of the Appalachian highlands and is comprised of upper Mesozoic and Cenozoic sedimentary sections that pinch out to the west and thicken and dip as they disappear under the Continental Shelf to the east. The sediments of the Georges Bank region are equivalents of these Coastal Plain deposits, with the exception of a more complete, and thicker, Mesozoic Section.

b. Marine

The North Atlantic Continental Shelf, Slope, and Rise in the Proposed Sale area is structurally dominated by the Georges Bank Basin, a structural depression in the crystalline basement rock. It is approximately 280 km (174 miles) long and 150 km (93 miles) wide. The Basin was formed at roughly the same geologic time and under similar stresses as the Baltimore Canyon Trough. Geologists believe that during the initial opening of the Atlantic Ocean, either during the Permian (Emery et al, 1970) or Triassic (Hallam, 1971), opposing rotations of the American plate and African plate created tensional forces, resulting in the formation of large fault blocks in what is now considered basement rock of the Basin. As a result of extensive erosion and transport of onshore components, sand gravel and clay filled the Basin, leading to further depression of it.

Four major depositional sequences have been delineated in the Georges Bank Basin by means of acoustic surveys: (1) Triassic (?) and Lower Jurassic non-marine clastic rocks (rocks composed of individual grains, fragments, or constituents of detrital material or sedimentary rocks produced by physical breakdown of a larger mass) (Lapedes, 1978) and evaporite deposits; (2) Non-marine clastic rocks and marine carbonates of Middle and upper Jurassic age; (3) Cretaceous marine and non-marine clastic sedimentary rocks; and (4) Cenozoic marine and glacial sediments (Schlee et al, 1979a).

The present surficial morphology of the North Atlantic Continental Shelf (the relatively smooth, gently dipping portion of the continental margin extending seaward to a depth of roughly 200 meters) reflects Pleistocene and Holocene events. Major marine regressions and transgressions occurred during the Pleistocene in response to advance and retreat, respectively, of glacial ice sheets. During the last low stand of sea level, ice-fed streams carried glacial outwash gravels and sands onto the shelf. Major rivers flowed across the shelf to submarine canyons on the shelf edge and deposited further sediment. As the glacial ice melted during later periods of geologic time, the migration of the rivers back across the shelf resulted in the formation of shoreline sedimentary complexes and associated stream valley features on the shelf. Present day oceanographic conditions have and still are modifying and altering the surficial sedimentary section (Aaron et al, 1980).

The major surficial features found on the shelf in the Georges Bank region are the fields of sand waves which are common in water depths of 60 m or less, and are typically 5 to 15 m in height and 150-to 750 m long. Geological studies noting the sharp asymmetry of these sand waves suggest that they are still active, although migrational information is lacking (Lewis et al, 1980). The ongoing sand wave activity is also indicative of an intense current and wave regime. These factors are considered constraints to oil and gas activity. Other potential hazards or constraints present on the North Atlantic Continental Shelf include buried channels and associated unstable shallow sediments.

The Georges Bank Continental Slope, on which most of the proposed tracts lie, is a steep, narrow area paralleling the shelf and extending from the shelf break to depths of about 2000 meters (6600 feet). The width of the slope is about 20 to 25 km and has an average gradient of about 6 degrees (Trigom, 1976, BLM-ESP). The Slope surface exhibits hummocky topography with gullies and terraces cutting across the surface. Numerous submarine canyons, formed by erosion when rivers and streams meandered out across the shelf during the glacial ages, are present (Shepard, 1973).

Seismic studies indicate that much of the seaward edge of the Georges Bank Basin (in approximately the 1000-to 2000 m range) lies over a carbonate reef-platform complex. This complex is buried under the terrigenous, clastic sediments which accumulated during the marine transgressions of the late Cretaceous and early Tertiary (Schlee and Grow, 1980). This reef complex apparently extends, intermittently, from the northern Gulf of Mexico out along the U.S. Atlantic margin. Seaward of this carbonate reef platform, Jurassic and early Cretaceous fore-reef slope facies mantle older oceanic crust beneath the Slope and Continental Rise (Schlee et al, 1979b). The possibility exists that black shales present in the North Atlantic basin may have intermingled with the carbonate reef to form structural traps favorable for the accumulation of petroleum (Arthur and Schlanger, 1979).

Surface deposits of the Georges Bank Continental Slope consist primarily of fine-grained modern sediments (silt and clay). These sediments may be susceptible to gravity-induced creeping and slumping, particularly on the Upper Slope and in the canyons.

The Continental Rise is a gently sloping, wide sedimentary apron extending from the base of the Continental Slope. Several of the tracts for Proposed Sale No. 52 lie on the Upper Rise. Deep-sea drilling data off the New Jersey coast revealed thick sequences of well-stratified Oligocene and Eocene pelagic material (particularly chert) overlying Cretaceous hemipelagic deposits. These units overlie Jurassic limestones umderlain by basaltic oceanic basement material (Ewing and Hollister, 1972). Similar units would be expected to exist on the North Atlantic Continental Rise.

The surficial sediments of the Continental Rise are predominantly fine silts and clays. Several factors play an active role in dispersing this sediment: turbidity currents, contour currents and gravity settling of material from the sea-water column. Turbidity currents flow down the submarine canyons and form channel systems on the rise contributing to the accumulation of sediment. Schlee (1973), however, has noted that turbidity currents play a minor role as depositional agents on the Upper Rise, while gravity settling dominates. Contour currents are currents involved in the overall circulation of the deep waters of the ocean. Minimal data is available relating to active processes on the Continental Rise, particularly those that might pose a danger to oil and gas operations. Potential hazards and constraints present on the rise would appear to include filled channels, deep ocean currents and scour, and shallow gas-filled pockets present in the sediment layers.

2. Meteorology

Ocean circulation, restriction to surface operations and the dispersion of ocean pollutants are directly influenced by meteorological factors. Surface winds, tropical and extratropical storms, air temperature, visibility, and superstructure icing are the most influencial meteorological parameters in the Sale Area. Icebergs are of no concern in this area.

Westerly and northwesterly surface winds prevail over the entire Sale Area during winter, October through March; vector mean wind speeds are between seven to twelve knots (kt) during this time of the year, with the highest values most commonly found in the eastern offshore regions of the Area. During June, July, and August southwesterly wind flow dominates most of the Area; vector mean wind speeds in these months range from three to six knots, with the highest values occurring, as in winter, in the eastern reaches of the Sale Area (Godshall, et. al., 1980; BLM-ESP). For a general coverage of surface winds over the entire North Atlantic region see FEIS for Sale No. 42, Table II-2.

Storms which pass through the Area have either a tropical or an extratropical origin. The tropical cyclones originate over the warm waters of the Caribbean, Gulf of Mexico, or the Atlantic Ocean south of Cape Hatteras, North Carolina. Tropical storms (winds of 34 to 63 kt) and hurricanes (winds greater than 63 kt) move into the Area along the East Coast or offshore during late summer and autumn (Godshall, et. al., 1980; BLM-ESP). Before arriving in the Sale Area, many of these storms have taken some of the features of extratropical

cyclones, and are less intense than they are in southern latitudes. However, the Sale Area is unprotected by Cape Cod and thus more vulnerable to these storms than those regions north of the Cape.

Hurricanes can be accompanied by winds with speeds of 63-100 kt; but the fetch in these storms is relatively short when compared to that of extratropical storms.

Extratropical storms enter the Sale Area either from the west or the southwest. Those which move through the Area from the southwest, Nor'easter storm, can be particularly severe in terms of precipitation and winds. Nor'easters are more frequent and intense between October and April (see Table III. A.2). Heavy snow, rain, and gales of hurricane force can accompany the passage of these extensive (600-1500 nmi) Low Pressure storm systems. Maximum wind speeds, however, rarely exceed 70 kt. The long fetch available to Nor'easters, The North Atlantic Ocean, accounts for the large waves that usually accompany them.

Table III.A.2

Storm winds greater than 34 kt: Frequency of observation by month (percent of observations) at Georges Shoals. Adapted from Godshall, et. al., 1980.

Month	Percent of observation with storm winds greater than 34 kt
December	11.1
January	13.9
February	11.6
March	13.2
April	7.9
May	2.3
June	0.8
July	0.7
August	0.9
September	2.1
October	6.9
November	4.1

Although freezing temperatures are observed in the Sale Area, they are recorded most frequently at coastal locations. At Georges and Nantucket Shoals, and Nantucket Light stations the percent occurrences of air temperatures less than or equal to 0°C (32°F) which persist for periods of less than three days in January is 75, 65 and 75, respectively (Godshall, et. al., 1980; BLM-ESP). Absolute minima of -13.3°C (8°F) has been observed during the winter, whereas temperatures as high as 32°C (90°F) have been recorded during the summer months. Average air temperatures in the Area ranges from approximately 4°C (39°F) during the winter months - December, January, February - to approximately 19°C (66°F) during the summer - June, July, August (adapted from Havens et. al., 1972).

Visibility, commonly defined as the maximum distance at which a prominent object can be seen against the background, can be restricted by precipitation (rain or snow), fog and spray. Percent frequency of visibility restricted to less than 0.5 nmi is highest during May, June and July: 11.6%, 12.8% and 11.0%, respectively. During the same months, visibility is restricted to less than 2.0 nmi 15.4% in May, 17.7% in June, and 16.1% in July.

The potential for accretion of ice on the superstructure of ships depends on the formation of spray and the temperature of the air and sea surface. In the North Atlantic region, November through March are the months when superstructure icing can be expected. In the Sale Area, December through March are the months with the highest frequency of icing potential. Light ice accretion (1-3 cm/24 hour) occurs less than 7% of the time in January; icing potential is highest during February occurring approximately 17% of the time. Moderate ice accretion (4-6 cm/24 hour) is less than 1% any month of the year. There is a marked decrease in icing potential frequencies as we move offshore from the New England coast. Severe, 7-14 cm/24 hour, and very severe, greater than 15 cm/24 hour, icing potential is not expected to occur in the Sale Area (Godshall, et. al., 1980; BLM-ESP).

3. Physical Oceanography

The proposed Sale area falls under the oceanographic regime characteristic of the southwestern quadrant of the Georges Bank, proper. Approximately 90% of the tracts lie on the shelf and slope waters; the remaining tracts, approximately 9% total of the total number, are located in the continental rise.

The seven northernmost tracts, those found in water depths less than 60 meters, lie in waters that, due to tidal and wave action, are vertically well mixed. At approximately 100-m depth countour, a shelf-slope front seperates the fresher, cooler waters of the shelf from the relatively warm, more saline waters of the slope (Bothner et. al., 1980). From summer to winter, this frontal zone migrates from the shelf to the shelf edge or upper slope (Bumpus, 1976). The frontal zone seems an area of increase turbulence with possible resuspension of bottom sediments (Flagg and Beardsley, 1978; Bothner et. al., 1980). The northeast-bound Gulf Stream flows seaward of the slope and continental rise regions of the proposed Sale area.

Circulation

The general circulation of the entire Georges Bank region has been described as a clockwise gyre (Bigelow, 1927; Bumpus, 1976; EG&G, 1979; EG&G, 1980). The mean circulation in the southwestern quadrant, the Sale area, appears to consist of a southwesterly drift towards the Mid-Atlantic Bight with a northerly veering branch joining the circulation in the northern flank of the Bank after flowing through the eastern side of the Great South Channel.

The circulation in the shallowest part of the proposed Sale area (water depths of 60 meters or less - the "top" of the Bank) is strongly dependent on the

tidal currents. Bohner et. al. (1980) and Moody and Butman (1980) mention - respectively, current speeds of 75 cm/s (1.5 kt) and 100 cm/s (2 kt). At the surface, a slow drift of approximately 5 cm/s towards the southwest has been observed (EG&G, 1980). A pernanent subsurface clockwise circulation in these shallow areas has been suggested (Butman et. al., 1980).

The shelf waters flow westward at 10 cm/s, 0.2 kt, (Butman et. al, 1980). The surface circulation has an offshore (away from the Bank) component; currents at the 100-20 m depth are approximately aligned with the topography of the Bank. A persistent southwestward flow is found at depths of 45- and 75-m at speeds of 9- and 4 cm/s, respectively. This flow diverges south of the Great South Channel. The main branch, greater than 70% of the flow, continues towards the Mid-Atlantic Bight; the lesser flow turns northward into the Great South Channel and seemingly joins the northeast current flowing along the norther edge of Georges Bank (Butman et. al., 1980).

Circulation in the slope regions of the proposed Sale area consists of a highly variable southwestward flow; speeds of about 13 cm/s have been recorded (EG&G, 1979). The intermittent presence in this region of Gulf Stream eddies contribute to the differences between waters of the slope and those of the shelf (EG&G, 1979).

An idealized circulation of the North Atlantic region is shown in Visual No. 4; for a more detailed description of ocean circulation of this area, see also FEIS for Sale No. 42.

Tidal Currents

Seidiurnal and strong rotary tidal currents are a major feature of the entire Georges Bank region particularly, as was already mentioned under Circulation, within the 60-m contour. The near surface (15 m) tidal currents within the proposed Sale area are strongest on top of the Bank (in water depths less than 60 m) and in the Great South Channel, where speeds of 76- and 74 cm/s, respectively, have been reported (Moody and Butman, 1980). The same authors mention speeds of about 40 cm/s occurring in the south flank of the Bank.

Surface Waves

For the entire North Atlantic region, we quote Godshall et. al. (1980) "A seasonal pattern of large (greater than 3 m) waves propagating from the northwest and west during winter and significantly smaller waves (equal to or less than 2 m) propagating from the south and southwest in the summer months." The median winter significant wave height is approximately 7 ft (2.0 m) for the entire region, while for the summer it is approximately 3.3 ft (1.0 m).

For the proposed Sale area, percent frequency of various wave heights during January (winter) and July (summer) follows.

Month	Wave height (1 m) 3 ft	(1.8 m) 6 ft	(3 m) 10 ft	(6.1 m) 20 ft
January	90%	35%	22%	2.5%
July	50%	10%	1%	Less than 1%

Source: Godshall et. al., 1980.

According to wave data gathered by Neu (1972) the one-year maximum wave height over Georges Bank is 36- to 40 feet; 11- to 12 m (Sale No. 42 FEIS). Statistically, wave heights for 10- and 100-year return period were estimated to be approximately 60 ft (18 m) and 73 ft (22 m), respectively (Godshall et. al., 1980).

Canyon Circulation

The evidence is inconclusive as to whether flow in the East Coast submarine canyons is up or down the axis of the canyons. Trunbull and McCamis (1967) reported a down-the-axis flow. A flow up the axis of Hatteras Canyon was observed by Rowe (1971); transport of sediments down this canyon's axis, however, is also reported by the same author. It should be noted, though, that sediment transport is dependent on gravity and speed of the flow.

Gulf Stream Eddies

About 5 to 10 warm core, anticyclonic eddies that originate in meanderings of the Gulf Stream move through the continental rise and the slope waters of the proposed Sale area each year. Eddies have a typical radius of 100 km (about 63 mi), rotate clockwise at approximate speeds of 100 cm/s (2 kt) while moving westward at approximately 5 km/day (about 3 mi/day) (Lai and Richardson, 1977). They remain between the Gulf Stream and the shelf break, playing a seemingly important role in the mixing of shelf and slope waters (Morgan and Bishop, 1977).

A net transfer of water on and off the shelf may result from the interaction of eddies and the continental shelf waters. Eddies are known to push higher salinity water onto the shelf and pull fresher water off the shelf. During the passage of an eddy through the proposed Sale area in fall 1977, EG&G (1980) reports that about 12% of the water of Georges Bank was drawn off. Approximately 75% of the replacement of this water came from the eddy itself; the remaining had its source in the Gulf of Maine. Satellite data show between five and ten eddies per year passing through the Proposed Sale area, causing a net exchange of Bank waters of 10-20% (EG&G, 1980).

Water Masses Residence Time

Data on residence time of water masses are limited. EG&G (1980) reports - based on drifter data - a residence time for the entire Georges Bank that increases gradually from a minimum in the winter to a maximum in the fall. For estimating residence time, the entire area of Georges Bank and vicinity are divided into two regions: within the 100-fathom (183-m) depth contour, the Georges Bank; and a second region, The Georges Bank Region. The latter overlaps the first and extends out beyond the 1000-fathom (2000-m) isobath. Table III.A.3 gives residence time (in days) based on initial drogue location in both those regions.

Table III.A.3. Residence Time Estimates Based on Initial Drogue Positions for Two Regions in the Georges Bank Area and Vicinity.

	December 1978 Results		March 1979 Results		May/June 1979 Results		August 1979 Results	
Initial Location	Time Inside 100-fa Contour	Time Inside Georges Bank Region Out to/ Beyond 1000-fa Contour	Time Inside 100-fa Contour	Time Inside Georges Bank Region Out to/ Beyond 1000-fa Contour	Time Inside 100-fa Contour	Time Inside Georges Bank Region Out to/ Beyond 1000-fa Contour	Time Inside 100-fa Contour	Time Inside Georges Bank Region Out Beyond 1000-fa Contour
Top of Bank	10	46	54 +	54 +	66 +	66 +	15 +	15 +
South Flank	4	45	----	----	72	72	60	64
Northwest Corner of Bank	34	39	26	48	27	58	67	71
Great South Channel	34	39	26	48	25	25	25	26

Source: EG&G (1980)

4. Air Quality

The Environmental Protection Agency has established primary and secondary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), photochemical oxidants (ozone, Ox) total suspended particulates (TSP), and lead. These standards (see Table III.A.4-1) were published on April 30, 1971 in 42 CFR 410, and recodified to CFR 50 on November 25, 1972. The primary air quality standards are designed to protect public health, while the more restrictive secondary standards are intended to protect public welfare, including aesthetic values.

The 1977 Clean Air Act Amendments require all areas of the country to be categorized according to their NAAQS attainment/non-attainment status for criteria pollutants. Also, states have been required to submit State Implementation Plans for attaining NAAQS. Each of the states where on-shore sale-related facilities may be located - Rhode Island, Massachusetts, New York - have submitted State Implementation Plans for EPA approval. Coastal areas within these states that are not in attainment for primary standards are given in Table III.A.4-1.

Within the State of Rhode Island the only area of non-attainment for CO and TSP is the City of Providence. Providence also has the highest SO_2 levels within the state, although NAAQS for this pollutant are still being met. By 1982, however, Providence is expected to be in attainment for CO. Ozone levels are non-attainment throughout the State (State of Rhode Island, 1979).

Within eastern Massachusetts, CO is currently non-attainment within several areas (see Table III.A.4-2). Ozone is non-attainment throughout the state. Although many areas throughout the region are non-attainment for the secondary TSP standard, none have been designated non-attainment for the primary standard. Most areas, throughout the region, however, have not been classified.

Within the metropolitan New York City - New Jersey region CO and ozone are non-attainment in many areas (see Table III.A.4-2). Also, although the primary standard for TSP is being met, the secondary standard is non-attainment throughout New York City. However, 1980 sampling data for the region indicates that for that year there were no violations of any standards for TSP, SO_2, NO_x and lead. (New York State Dept. of Environmental Conservation, 1980).

5. Water Quality

The materials of primary concern that could increase in the water column as a result of offshore oil and gas operations and thereby affect water quality are hydrocarbons, particulate matter, and heavy metals such as barium, chromium, aluminum, copper, iron, lead, nickel and zinc. (See Section IV.A.3, Impact Producing Factors Water Pollutants). Therefore, the distribution of these materials in the water column shall be the main focus of this discussion. Other water quality parameters are extensively discussed in the FEIS for Sale No. 42.

Table III.A.4-1
National Ambient Air Quality Standards[a]

Pollutant	Averaging Time	Primary Standard	Secondary Standard
Oxidant (Ozone)	1 hour	160 ug/m^3 (0.08 ppm)	Same as Primary Stds.
Carbon Monoxide	12 hour		Same as Primary Stds.
	8 hour	10 mg/m^3 (9 ppm)	
	1 hour	40 mg/m^3 (35 ppm)	
Nitrogen Dioxide	Annual Average	100 ug/m^3 (0.05 ppm)	Same as Primary Stds.
	1 hour		
Sulfur Dioxide	Annual Average	80 ug/m^3 (0.03 ppm)	
	24 hour	365 ug/m^3 (0.14 ppm)	
	3 hour		1,300 ug/m^3 (0.5 ppm)
	1 hour		
Visibility	1 Observation		
Suspended Particulate Matter	Annual Geometric Mean	75 ug/m^3	60 ug/m^3
	24 hour	260 ug/m^3	150 ug/m^3
Sulfates	24 hour		
Lead	30 day average		
Hydrogen Sulfide	1 hour		
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	160 ug/m^3 (0.24 ppm)	Same as Primary Stds.
Ethylene	8 hour		
	1 hour		

[a]National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

Table III.A.4-2 Areas Non-Attainment for Primary National Ambient Air Quality Standards

State	Air Quality Control Region	Pollutant	Designated Areas
Rhode Island	Metropolitan Providence Interstate	Ox	Entire Region
		CO	Providence
		TSP	Providence
Massachusetts	Metropolitan Boston	Ox	Entire Region
		CO	Boston, Cambridge, Medford, Waltham
	Merrimack Valley	Ox	Entire Region
		CO	Lowell
New York	New Jersey - New York - Connecticutt Interstate	Ox	Entire Region
		CO	New York City (all boroughs), Yonkers, Mt. Vernon, Nassau County
New Jersey	New Jersey - New York - Connecticut Interstate	Ox	Entire Region
		CO	Patterson, Hackensack, Newark, Elizabeth, Morristown, Perth Amboy, Somerville, Asbury Park, Freehold

Georges Bank Region

A BLM-sponsored benchmark study of the Georges Bank region was conducted by Energy Resources Company, Inc. (ERCO, 1978). Hydrocarbons, total suspended particulate matter, and particulate trace metals were among the parameters investigated as part of the study (see ERCO 1978; Boehm, et. al., 1979).

Basically, hydrocarbon compounds were found to be ubiquitous throughout the region. Dissolved and particulate hydrocarbons in the water column reflected inputs from chronic tanker, shipping, and fishing vessel operations, and from the break-up of the tanker Argo Merchant which went aground December 15, 1976 on an area of shoals located 29 nautical miles southeast of Nantucket, spilling 7.7 million gallons of No. 6 fuel oil.

In the water column on Georges Bank and Nantucket Shoals, concentrations of the dissolved hydrocarbon fraction were generally higher than the particulate fraction. Throughout the year, dissolved hydrocarbons were generally in the 0.1 part per billion (ppb) to 2.0 ppb range, but were above 10 ppb during the four months following the Argo Merchant spill. Lowest

concentrations occurred during the fall, when Slope water intrusion was present over the Bank. Hydrocarbon distribution was patchy, but overall, lower concentrations were found in Slope waters. Vertical distribution throughout the water column did not correlate with depth.

Hydrocarbons associated with particulate matter were contributed by both biogenic and petrogenic sources. Throughout the year particulate hydrocarbon levels were generally low, ranging from 0.01 to 5.31 micrograms per liter (ug/l) and averaging 0.72 ug/l.

Concentrations of total suspended particulate matter ranged from 0.06 to nearly 1.00 milligram per liter (mg/l). Highest concentrations occurred in winter and spring over the Bank, while lowest levels were observed in summer and fall. When Slope water intrusion was present over the Bank in the fall, concentrations were less than 0.1 mg/l.

Concentrations of particulate matter in the Gulf of Maine and over the Slope were typically lower (0.06 to 0.52 mg/l) than those over the Bank. Overall, both total suspended matter and particulate trace metals were found to be lower in Slope waters than for any other water type within the region.

Much of the particulate trace metal over Georges Bank was found to be associated with organic matter, although originating primarily from inorganic sources. Levels were generally higher during the winter and spring.

Particulate copper and lead showed near-shore enrichments, with lower levels occurring over the Bank, Great South Channel, and in the Gulf of Maine. Nickel also showed near-shore elevations, with highest values in summer, but gradients decreased over Georges Bank, and in many areas were undetectable (ERCO, 1978).

Chromium and zinc had highest levels in spring. Chromium levels were higher nearshore in winter and spring than at outer Bank stations. Such nearshore increases were due to terrestrial runoff or atmospheric deposition. Unlike most other metals, zinc, however, did not appear to be enriched nearshore. Levels of particulate copper, lead, and chromium were lower in Slope water than in any other water type (ERCO, 1978).

Table III.A.5-1 summarizes average trace metal concentrations for several water types within the Georges Bank region, based on samples collected during four ERCO cruises.

Table III.A.5-1

Chemical Characteriztion of Water Types in the Georges Bank Region: Summary for 4 Cruises

Parameter	Coastal	Surface Shelf	Shelf/Slope Transition Water	Slope
		Average Concentrations		
Cu (ng/1)	38.0	25.0- 43.0	39.0 - 54.0	18.0- 27.0
Cd (ng/1)	1.0	0.5- 6.7	5.3 - 6.0	1.5- 3.9
Pb (ng/1)	170.0	42.0- 327.0	66.0 -164.0	23.0- 69.0
Ni (ng/1)	1.2	20.0-1,210.0	12.0 -217.0	0.8- 21.0
Cr (ng/1)	33.0	89.0- 41.0	5.0 - 47.0	3.1- 18.0
Fe (ug/1)	5.9	0.4- 4.3	1.0 - 3.1	2.3- 7.9
Zn (ug/1)	1.9	0.1- 4.4	0.4 - 4.6	0.2- 2.7
TSM1 (mg/1)	0.23	0.27- 0.32	0.12- 0.45	0.11- 0.21
PO2 (mg/1)	289.0	113.0 - 136.0	79.0- 121.0	2.59

1 Total Suspended Matter
2 Particulate Organic Carbon

From: ERCO, 1978

Narragansett Bay

As most of the commerce on Narragansett Bay is petroleum-related (FEIS for Sale No. 42, p. 228) a major source of pollution within the Bay is oil spilled during transport. Duce et. al. (1972) found hydrocarbon background levels of 8.5 ug/1 in the surface microlayer of the Bay water column and 5.9 ug/1 at a depth of 0.2 meters (CNA, 1977). More recently, ERCO (1978) found hydrocarbon values in the Bay to range from 5 to 15 ug/1.

Kester and Courant (1973) found relatively high increases of manganese, nickel, cooper and zinc near the head of the Bay as a result of industrial and domestic discharges (TRIGOM, 1974).

Recently, the upper Bay has been subject to intermittent sources of pollution due mainly to the combined sewer overflows in Provindence, Pawtucket and Central Falls, and to failures at six major wastewater treatment facilities. The result has been periodic closure to shellfishing in the area (State of Rhode Island, 1980).

New York Harbor including Raritan Bay

Pollution loadings to the New York Harbor complex are large, despite extensive water pollution control efforts in the region. Water quality problems include sewage discharges, oil and grease, inadequate dissolved oxygen for marine life, excessive bacterial densities, and high concentrations of heavy metals, polychlorinated biphenyls (PCB's) and other potentially toxic substances. However, the overall impact of direct industrial discharges on the Harbor is considered to be of relatively little significance when compared to the municipal point source discharges (The City of New York, 1979).

Searle *et. al.* (1977) found non-volatile hydrocarbons to range from 14 to 270 ug/1, which was about 10 times higher than that obtained in the open ocean. Hydrocarbons in Raritan Bay averaged 36 ug/1 in November, 37 ug/1 in March, and 18 ug/1 in June.

Copper, lead, mercury, nickel and zinc occur in concentrations potentially toxic to marine life, while cadmium and chromium are generally below hazardous levels. There are also high "spot" concentrations of aluminum, silver, cobalt, tin and possibly arsenic in the Harbor (The City of New York, 1979).

B. Biological Environment

1. Marine Resources

a. Plankton

The offshore and nearshore plankton communities in the region have been previously summarized (See FES OCS Sale No. 42, p. 272-320; Trigom, 1974 BLM ESP).

The major types of phytoplankton within the North Atlantic Area are the diatoms, dinoflagellates, coccolithophores, silicoflagellates, euglenoids, blue-green algaem and microflagellates (Smayda, 1973). Through the studies of Bigelow (1926), Lillick (1940), Sears (1941) and EG&G (1979, 1980-BLM ESP) a general description of phytoplankton succession on Georges Bank can be made. There is a monthly progression of species with a high degree of annual variability. The winter is dominated by *Prorocentrum micans* and *Thalassionema nitzschioides*. This is the period of lowest cell numbers. A spring bloom of diatoms usually dominated by *Thalassiosira nordenskioldii* can have cell concentrations exceeding 106 cells/liter. Late spring shows a shift in species dominated by members of the genus *Chaetoceros*. Average cell densities at this time are approximately 20,000 cells/liter (Sears, 1941; EG&G, 1979). Lillick (1940), Sears (1941), and EG&G (1980) indicated summer abundance was similar to late spring, again characterized by a diverse *Chaetoceros* flora. Lillick (1938) recorded a very patchy flora during the autumn months. Riley's (1941) data supported a spring and fall bloom pattern of primary productivity. Recent investigations (Cohen & Wright, 1979) suggest that there is no summer depression of productivity.

The distribution of the larger planktonic crustacea on Georges Bank were reported by Whitley (1948). Clark et. al. (1943) reported on the distribution of *Sagitta elegans*. The significance of this chaetognath lies in its widespread abundance over the Banks and its ecological role as a major predator upon the smaller zooplankton. The euphausids, particularly *Thysanoessa inermis*, *Meganyctiphanes norvegica*, and *Thermisto compressa*, are food organisms for herring. Another important source of food for herring among the zooplankton is *Calanus finmarchicus*. Sherman et. al. (1978) summarized the results of spring and autumn zooplankton surveys for 1971 through 1975 to illustrate long-term variation in abundance of the dominant capepods. Pavishtics (1963) described the distribution of the copepod community over Georges Bank. The areas of greatest copepod abundance occurred along the north and northwest slopes of the Banks. The seasonal and year-to-year patterns show that the zooplankton community on Georges Bank is characterized by substantial variation of species dominance and abundance.

TRIGOM (1974) summarized the distribution and life history characteristics of 24 of the more important species within the North Atlantic area.

The distribution of ichthyoplankton collected during ICNAF larval herring surveys on Georges Bank and Gulf of Maine from 1971 to 1975 have been described (Colton and Byron, 1977). The bank is the known spawning ground for at least 26 fish species and characteristics were summarized in TRIGOM (1974) and their spawning times and locations by Cocton et. al. (1979).

b. Benthos

The general distribution of the benthic fauna from the North Atlantic has been previously summarized in TRIGOM-ESP (1974) and FES OCS Sale No. 42 (1979). The bulk of the Georges Bank benthic fauna is comprised of four major taxonomic groups: Annelida, Crustacea, Mollusca, and Echinodermata (Wigley, 1961).

For the North Atlantic region, four sediment types, each with a characteristic fauna have been described (Wigley, 1968). They include sand, silt-sand, gravel, and silt-clay (mud) bottoms. Table III.B.1.b-1 lists some of the representative species from these different sediment types. Georges Bank sediments consist mainly of sands of various sizes. Some of the areas which can be designated silty-sand include southern Georges Bank and the deeper portions of Nantucket Shoals. A thin layer of flocculent organic material often covers the sediment surface in these areas (Pratt, 1973). The distribution of the ocean quahog (*Arctica islandica*) can be used to a limited fauna (Pratt, 1973). Gravels are most common in the channels and on the northern and eastern parts of the Bank. Silts and clays often associated with high concentrations of organic and inorganic elements are found in the deepwater basins. Although the silt-clay biotype has a relatively low productivity, the fauna supports populations of groundfish as well as lobster migrating near the edge of the Continental Shelf (Pratt, 1973).

Table III.B.1.b-1. Common Organisms Associated with Principal Bottom Types on Georges Bank(1)

Scientific Name	Common Name	Typical Locality of Occurrence
Sand Fauna:		
Crustacea		Central Georges Bank Often moderating shallow water
Chiridotea	Isopod	
Crangon septemspinosis	sand shrimp	
Haustoridae, Phoxocephalidae	amphipods, beach fleas	
Leptocuma	cumacean	
Pagurus acadianus	hermit crab	
Abbekuda		
Clymenella	polychaete worm	
Goniadella	polychaete worm	
Ophelia	polychaete worm	
Mollusca		
Astarte castanea	bivalve, chestnut astarte	
Lunatia heros	gastropod, snail	
Nassaurius trivitattus	gastropod, snail	
Spisula solidissima	surf clam	
Echinodermata		
Echinarachnius parma	sand dollar	
Silty Sand Fauna:		
Coelenterata		Southern margin of Georges Bank, deeper water
Cerianthus	Tube aneomone	
Crustacea		
Ampelisca compressa	amphipod	
Ampelisca vadorum	amphipod	
Diastylis	cumacean	
Dichelopandalus	shrimp	
Edotea	isopod	
Annelida		
Harmothoe	polychaete worm	
Nephtys	polychaete worm	
Scalibregma	polychaete worm	
Mollusca		
Arctica islandica	ocean quahog	
Colus pygmaeus	gastropod, pygmy distaff shell	
Crenella	bivalve	
Nucula	bivalve	
Venericardia	bivalve	
Echinodermata		
Amphilimna	brittlestar	
Amphioplus	brittlestar	
Thyone scabra	burrowing sea cucumber	
Gravel Fauna:		
Porifera		Northeastern Georges Bank, parts of Great South Channel, generally shallow water
Clionia	sponge	
Myxilla	sponge	
Polymastia	sponge	
Coelenterata		
Bouganvillia	hydroid	
Eudendrium	hydroid	
Gersemia	coral	
Paragoria	coral	
Sertularia	hydroid	
Tubularia	hydroid	

Table III.B.1.b-1. (continued)

Scientific Name	Common Name	Typically Locality of Occurrence
Crustacea		
Balanus crenatus	barnacle	
Balanus hameri	barnacle	
Hyas	toad crab	
Annelida		
Chone	polychaete worm	
Serpula	polychaete worm	
Spiorbis	polychaete worm	
Brachiopoda		
Terebratulina	lampshell	
Mollusca		
Anomia	bivalve	
Dendronotus	nudibranch	
Doris	nudibranch	
Modiolus modiolus	bivalve	
Musculus	bivalve	
Neptunea	gastropod, snail	
Placopecten magellanicus	bivalve, scallop	
Echinodermata		
Crossaster	starfish	
Ophiacantha	brittestar	
Ophiopholis	brittestar	
Solaster	starfish	
Urochordata		
Amaroucium	tunicate	
Ascidia	tunicate	
Boltenia	tunicate	
Muddy Basin Fauna:		
Crustacea		Deepwater between fishing banks
Calocaris	shrimp	
Geryon	crab	
Haploops tubicola	amphipod	
Munnopsis typica	isopod	
Pandalus	shrimp	
Annelida		
Amphitrite	polychaete worm	
Leanira	polychaete worm	
Onuphis	polychaete worm	
Sternaspis	polychaete worm	
Mollusca		
Cadulus	scaphopod, tusk shell	
Dentalium	scaphopod, tusk shell	
Modiolaria discors	bivalve	
Scaphander	gastropod, snail	
Echinodermata		
Amphiura otteri	brittle star	
Briaster fragilis	heart urchin	
Ctenodiscus crispatus	mud star	
Ophiura robusta	brittle star	
Ophiura sarsi	brittle star	
Urochordata		
Polycarpa fibrosa	tunicate	

(1) Compiled from Wighley, 1968.

Bottom sediment composition is a major determinant of benthic invertebrate composition, abundance and distribution. The geographic distribution of benthic invertebrate biomass (wet. wt.) was described by Wigley (1961a, 1965). The biomass was high (100 g/m2) in three general areas of the bank: northeast, south-central, and western. The latter area was comprised of small discrete patches. More than 50% of the bank supported a low biomass (50 g/m2). Moderate levels of biomass (50-100 g/m2) were adjacent to all high biomass areas.

Wigley (1961a) observed that the total number of individuals and biomass was highest in coarse sediments and lowest in fine. The highest biomass (1300 g/m2) was on gravel and sand-gravel bottoms, largely due to dense beds of the northern horse mussel (*Modiolus modiolus*). Sediments dominated by the sand fraction supported a biomass of 14 to 154 g/m2 and sediments dominated by silt or clay fractions supported the lowest biomass.

Wigley (1965) found a strong correlation between groundfish and benthic invertebrates on Georges Bank. The large volume of information concerning abundance and distribution of benthic invertebrates at the Northeast Fisheries Center, Woods Hole has not been completely processed but several publications (Wigley, 1961a, b, 1965, 1968) have described the broad features of sediment and invertebrate distribution.

Four commercially valuable species of benthic invertebrates are widely distributed on the Bank: American lobster, surf clams, sea scallops, and ocean quahogs. Scallop beds sufficiently dense to support a fishery are usually found at depths between 25 and 100 meters and are generally distributed in a non-random pattern. Sea scallops occur primarily on sand or gravel bottoms (Bourne, 1964). Scallops are most abundant in the northeast, southeast and Great South Channel. The northeast supports the highest average characterized by densities of 200 scallops per 10,000 m2. the Great South Channel supported densities from 50 - 100 scallops per 10,000 m2. The beds are concentrated in well-defined areas, with the northern edge being the most productive historically and the southeast has been sporadic, but supports occasional large populations. A through discussion of the biology and ecology of sea scallops has been published by Bourne (1964), Merrill and Posgay (1964) and Mackenzie (1979).

Lobster (*Homarus americanus*) are found in virtually all parts of Georges Bank, with highest concentrations in the canyon heads along the southern tier. Cooper and Uzmann (1977) estimated an average density of lobster on the open shelf and upper slope was 0.001 individuals or 0.085 g/m2 and 0.05 individuals or 4.24 g/m2, respectively.

The ocean quahog (*Arctica islandica*) is distributed around the periphery of the Bank and prefers gentle currents and sandy sediments containing substantial qualities of silts and clays. Surf clams (*Spisula solidissima*) are distributed primarily over the northern half of the Bank, as they prefer coarse sands with low silt content, characteristic of the shallower regions of the Bank. Ropes (1978) recently summarized information of these species off the northeast coast of the U.S. There is generally no overlap in the distribution of surf clam and ocean quahogs on Georges Bank.

Red crab supports a small fishery in southern New England primarily out of New Bedford, Mass. and Point Judith, R.I. Aspects of the biology and distribution of this specie have been discussed by Wigley, Theroux, and Murray (1975).

According to Rowe (1971) the differences in distribution of species in canyon areas can be attributed to: (1) different hydrographic conditions due to interruption of the bottom current; (2) presence of areas of indurated sediments (3) higher concentrations of suspended matter providing food for filter feeders; (4) deposited organic matter providing food for deposit feeders. The abundance and distribution of the epibenthic fauna of Lydonia and Oceanographer Canyons was studied by Lamont-Doherty Geological Observatory (BLM ESP). The shallow water fauna in the canyons was similar to that found on the slope. It was composed of a variety of species that appeared to have somewhat discrete depth ranges. In general, the distribution was patchy. The fauna is usually dominated by three species, the crab Geryon quinquedens, and two demersal fish, Synaphobranchus kaupi and rattails. In areas of hard substrate shrimp, sponges and corals frequently predominate.

c. Pelagic Birds

Avian species that spend the majority of their life at sea, comming ashore only to breed or to avoid severe environmental conditions, are commonly referred to as pelagic birds. There are approximately 30 species of pelagic birds ranging from uncommon to abundant occurring in the Georges Bank region of the North Atlantic. Ten of these species are considered common or abundant in this region the year-round with the greatest numbers observed during the summer season (Table III.B.1.c.1). The Gulf of Maine region was found to support large numbers of these species during every season, except spring (Powers, Pittman, and Fitch, 1980). In addition, the Southern New England region was found to support relatively low numbers of birds the year round. Although pelagic bird abundance varied between these three regions, species diversity was generally shown to be greatest in each of these regions during the spring season. A further comparison among the three regions revealed that species diversity tended to be greatest in the Southern New England region, despite the relatively low numbers of birds in this region.

Spatial distribution of pelagic birds is generally dependent upon the distribution of prey species both natural and human related (i.e. fishing activities). Prey species are naturally concentrated in nutrient rich upwelling areas. In the North Atlantic these areas would include the shelf/slope area in general, the major submarine canyons (Visual #1), and the Nantucket shoals area. Powers, Pittman, and Fitch (1980) have also identified the New York Bight, and the southern flank and Northeast Peak of Georges Bank as seasonally important areas for some species. Low bird densities were recorded in the deeper Gulf of Maine waters and shallow areas of central Georges Bank. The distribution of several gull species appeared to be influenced predominantly by offshore fishing fleets from late fall to early spring. Fulmars, greater and sooty shearwaters, gannets, and black-legged kittiwakes were found to have a local and seasonal preference for fishing activities.

Table III.B.1.c-1. List of common or abundant seabirds occurring in the North-Atlantic region

Common name	Scientific name	Primary occurrence
Northern Fulmar	*Fulmarus glacialis*	Winter, spring
Cory's Shearwater	*Puffinus diomedea*	Summer, fall
Greater Shearwater	*Puffinus gravis*	Summer, fall
Sooty Shearwater	*Puffinus grisens*	Summer, fall
Wilson's Storm-Petrel	*Oceanites oceanicus*	Summer
Gannet	*Morus bassanus*	Spring, fall
Red Phalarope	*Phalaropus fulicarius*	Spring
Great Black-backed Gull	*Larus marinus*	Year-round, breeds
Herring Gull	*Larus argentatus*	Year-round, breeds
Black-legged kittiwake	*Rissa tridactyla*	Winter

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Sources: Erwin and Korschgen (1979), Fefer and Schettig (1980), Powers and Loughlin (1980), and Powers, Pittman, and Fitch (1980).

Several pelagic and nearshore species of seabirds breed in the coastal areas of each of the northeastern states with Maine harboring the largest nesting populations (Table III.B.2.c-1). Fourteen species have been identified as breeding residents of coastal Maine (Fefer and Schettig, 1980). Of particular concern is the Common Puffin as attempts are being made to reestablish a nesting colony on Eastern Egg Rock in Muscongus Bay, Maine. There is only one other known nesting colony in U.S. waters which is located on Matincus Rock, Maine.

d. Endangered and Threatened Species and Species of Concern

Marine Mammals

Pinnipeds

The coastal and nearshore waters of the North Atlantic region are inhabited by five species of pinnipeds (seals and walruses) ranging in occurrence from common to very rare. These species include the harbor, gray, harp, and hooded seals and the walrus. Only the harbor and gray seals occur in large numbers or with any regularity in the North Atlantic region. The distribution, habitat preference, and abundance of each species is listed in FES OCS Sale No. 42, Table II-49. None of these five species are on the federal list of endangered or threatened species.

In general, pinnipeds are concentrated along the rocky coastline of Maine which provides remote haulout areas that are used for feeding and resting by each species and for breeding and pupping by the harbor seal. The only other species that breeds in the North Atlantic region is the gray seal. A small group (10-15) of gray seals inhabits Muskeget Island which is due west of Nantucket Island, MA. This is the only known breeding colony in U.S. waters. However, this colony has produced only one or two pups since 1970 and the discreteness of this population is now questionable as marked Canadian seals have been seen in the vicinity of the island (Prescott, Kraus, and Gilbert, 1979).

Cetaceans

There are about 26 species of cetaceans (porpoises, dolphins, and whales) that inhabit the North Atlantic region. Their distribution, habitat preference, and estimated abundance are listed in Table III.B.1.d-1. Of these 26, approximately 16 can be found in the are on a seasonal or year round basis. Six species are endangered. They are the sei whale, the fin whale, the blue whale, the humpback whale, the right whale, and the sperm whale.

All six of the endangered whales can be found in the waters around the proposed lease sale area, with the possible exception of the blue whale. Preliminary findings of the BLM funded Cetacean and Turtle Assessment Program (CETAP) have indicated that very few blue whales occur in the region and all of those observed were sighted in the northern Gulf of Maine. Additional CETAP findings suggest that the Great South Channel is an important passageway for migrating humpback and right whales to enter (spring) and exit (fall) the Gulf of Maine and more northern waters.

Table III.B.1.d-1 Summary of Cetacean Species Found in the Western North Atlantic

Common Name	Scientific Name	Distribution and Habitat	Population Estimate
Minke whale	Balaenoptera acutorostrata	Sub-polar to tropical waters. Most common north of New York. A northward spring migration and southward fall migration has been noted. Most sitings are nearshore or within the 200m contour. Eats fish (herring, capelin, etc.)	No estimates. Relatively common north of New York.
*Sei whale	Balaenoptera borealis	Pelagic. Probably winters south of Cape Cod and summers from Cape Cod northward to southern Arctic. Feeds on copepods, krill and small fish by skimming at or below the water's surface.	A few thousand. Uncommon.
*Fin whale	Balaenoptera physalus	Found between shore and the 2000m contour. Present in all North Atlantic areas throughout the year but concentrated from Cape Cod north in the summer and south in winter. Probably a nearshore northerly spring migration and an offshore southerly fall migration. Possibly breeds in Mid-Atlantic. Feeds on krill, planktonic crustaceans and schooling fish (capelin, herring, etc.).	7200. Most common large baleen whale
*Blue whale	Balaenoptera musculus	Pelagic. Remaining individuals appear to be concentrated in waters from the Gulf of St. Lawrence north to Iceland. Limited north/south migrations probably occur, though little information is available. Feeds almost exclusively on krill.	Several hundred. Considered very rare in North Atlantic area.
*Humpback	Megaptera novaeangliae	Occurs in shallow coastal waters of the North Atlantic during the spring and summer. Feeding concentrations center around Cape Cod, Stellwagon Bank, Jeffreys Ledge, and the Great South Channel between Cape Cod and Georges Bank. Fall migration to southern breeding grounds in the Caribbean may occur over deeper ocean waters. Feeds on euphasids and small fish.	2000. North Atlantic is a migratory area and feeding ground.
*Right whale	Eubalaena glacialis	Found between shore and the 200m contour. Present in the waters around Cape Cod from April to May. By June, most animals are north of Cape Cod in summer feeding grounds. The offshore southern migration occurs from mid-October to early January. Feeds exclusively on plankton by skimming at or below the water's surface.	A few hundred in entire North Atlantic (including Europe).

Common Name	Scientific Name	Distribution and Habitat	Population Estimates
Bottlenose dolphin	*Tursiops truncatus*	Ranges from Florida through New England. Coastal in southern portion of range but north of North Carolina it begins to distribute offshore over the OCS. Probably winters south of Maryland. Eats fish and shrimp.	17,000
Atlantic spotted dolphin	*Stenella plagiodon*	Warm temperate and tropical waters. Most abundant south of Cape Hatteras. Has been reported as far north as Massachusetts. Usually found from 5 miles offshore to the 200m contour. Feeds primarily on squid, but also eats other fish.	No estimate.
Striped dolphin	*Stenella coeruleoalba*	Relatively abundant along the Continental Slope from Georges Bank and Sable Island, south through the Caribbean and Gulf of Mexico.	No estimate.
Saddleback dolphin (common dolphin)	*Delphinus delphis*	Pelagic, often found at the slope or beyond. Found along entire east coast. North of Cape Cod, the occurence is apparently seasonal. Appears to follow schools of fish on which it preys.	No estimate. Apparently common.
White-beaked dolphin	*Lagenorhynchus albirostris*	Generally an offshore species from Cape Cod northward. Cape Cod is apparently the southern boundary of its range where it is fairly common in April, May and June. Feeds on squid, cod, herring and capelin.	No estimate.
Atlantic whitesided dolphin	*Lagenorhynchus acutus*	Ranges from nearshore to offshore. Generally from Cape Cod, or perhaps Hudson Canyon, northward.	No estimate.
Whiteheaded grampus (Risso's dolphin)	*Grampus griseus*	Pelagic, especially along Continental Slope. Found from Florida to Cape Cod and possibly Canada. Feeds on squid and fish.	No estimate.

Common Name	Scientific Name	Distribution and Habitat	Population Estimates
Long fin pilot whale	Globicephala melaena	Pelagic (winter) and coastal (summer). Ranges from Greenland to Cape Hatteras.	No estimate. Frequently seen.
Short fin pilot whale	Globicephala machrorhynchus	Pelagic and nearshore. Normal range is from Cape Hatteras south, although strays are reported from as far north as New Jersey. Feeds on squid and fish.	No estimate. Only strays in northern waters.
Killer whale	Orcinus orca	Coastal and over the OCS ranging from Florida to the ice pack. Feeds on a wide variety of foods including squid, fish, turtles, seabirds and mammals.	No estimates. More common in northern waters.
Harbor porpoise	Phocoena phocoena	Coastal and inshore. Normal southern limit of range is Long Island. Strays as far south as Cape Hatteras. Population concentrated north of Cape Cod. Eats mostly fish (herring, cod, mackerel) and squid.	No estimate. Very common north of Cape Cod and rare south of New Jersey.
Beluga whale	Delphinapterus leucas	Shallow coastal waters and estuaries. Normal distribution is from the Gulf of St. Lawrence northward. Belugas from the St. Lawrence stock rarely stray to Cape Cod or Long Island during the warmer months.	Uncommon in New England waters.
*Sperm whale	Physeter catodon	Pelagic. Common along the continental slope and seaward but rarely on the shelf. Ranges from the tropics to the Arctic but females, calves and juveniles rarely migrate farther north than 40° -42° N. There is a north-south migratory pattern but the Mid-Atlantic is always inhabited with sperm whales. Feeds on squid.	North Atlantic population is estimated to be 22,000.
Pygmy sperm	Kogia breviceps	Seldom observed alive. Generally considered pelagic but the relatively high number of stranding incidents indicate it may be coastal also. Occurs from Canada to Florida. Feeds on squid, crab, shrimp.	No estimate.

Common Name	Scientific Name	Distribution and Habitat	Population Estimates
Goose-beaked whale	Ziphius cavirostris	Assumed to be a deepwater, pelagic species. Appears to be sparsely but widely distributed in non-polar latitudes. Most commonly stranded beaked whale on east coast.	No estimate.
North Atlantic bottlenosed whale	Hyperoodon ampullatus	Pelagic, usually found in water deeper than 1450m. Found from Rhode Island to the ice pack. Cape Cod is probably the southern extent of the wintering ground. Rare south of Canada. Feeds on squid.	No estimate.
True's beaked whale	Mesoplodon mirus	Possibly pelagic. Strandings occur from Nova Scotia to Florida. Little is known.	No estimate
Antillean beaked whale	Mesoplodon europaeus	Possibly a deep water species. Strandings are reported from Florida to New York. Little is known.	No estimate.
North Sea beaked whale	Mesoplodon bidens	Strandings reported from Nantucket and Newfoundland. Feeds on squid. Little is known.	No estimate.
Dense-beaked whale	Mesoplodon densirostris	Possibly most pelagic of the genus. Probably a warm-water species with northern limit at 45° N. Appears to be widely but sparsely distributed. Feeds on squid. Little is known.	No estimate.

Sources: Katona, Winn, and Steiner, 1977; Leatherwood, Caldwell and Winn, 1976; Marcuzzi and Pilleri, 1971; Mead, 1975; Mitchell, 1973; Prescott, Kraus, and Gilbert, 1979; Rice, 1977.

*Endangered Species

Feeding concentrations of these two species occur from late April to Mid-June in the upper portion of the Channel. It also appears that migrating humpback and right whales may utilize deeper waters along the continental slope and possibly the Gulf Stream much more than has been previously thought according to CETAP. If this trend is re-inforced by ongoing data collection and analysis, it will mean that these two species migrate through the proposed lease sale area bi-annually on their way to and from the Great South Channel.

Fin whales are prevalent throughout the North Atlantic region. These whales use the area as a feeding ground and during migration periods; however, fin whales are generally present in the area all year long. The sei and the sperm whales have been observed most frequently along the slope, which includes most of the proposed lease sale area. These whales are believed to be migrating (spring and fall) and feeding when they are present in the area which is generally most of the year.

Sea turtles

Three endangered and two threatened species of marine sea turtles occur in the waters of the North Atlantic. The three endangered species include the hawksbill (*Eretmochelys imbricata*), the leatherback (*Dermochelys coriacea*), and the Atlantic ridley (*Lepidochelys kempii*). The two threatened species are the loggerhead (*Caretta caretta*) and the green sea turtle (*Chelonia mydas*). The preliminary findings of CETAP, in agreement with turtle stranding reports (SEAN Bulletin for 1979), indicate that the loggerhead is the most abundant species in the region followed by the leatherback and then the Atlantic ridley, respectively. Green sea turtles prefer the warmer, more southern waters of the Mid and South Atlantic but have been recorded in small numbers in Nantucket Sound (Lazell, 1980). The hawksbill is generally considered to be only an accidental visitor to the North Atlantic. This species has not been observed by CETAP and there are no recent records of strandings in the Mid or North Atlantic regions.

The loggerhead is an omnivorous sea turtle that ranges from the bays, salt marshes, and estuaries of the coast to as far as 500 miles from shore and anywhere in between (Ernst and Barbour, 1972). CETAP findings indicate that this turtle is concentrated in shelf waters less than 60m in depth from Long Island south from mid-May through November. Although loggerhead nesting beaches are located predominantly south of Cape Hatteras, NC; there have been two confirmed nestings (1972 and 1979) and some digs and crawls along the New Jersey coast (Schoelkopf; NMFS; pers. comm. 1980).

The leatherback is a highly migratory, pelagic turtle that rarely enters shallow coastal waters. CETAP reports indicate leatherbacks are observed first in the Gulf of Maine in June. Sightings then occur throughout the North Atlantic and portions of the Mid-Atlantic until November. It is thought that the sudden appearance of these turtles in the Gulf of Maine may be the result of an offshore spring migration in the Gulf Stream. At some point, the turtles

would leave the Gulf Stream and enter the Gulf of Maine by way of the Great South Channel, the Northeast Channel, or by crossing over Georges Bank. It appears that the turtles feed in the Gulf of Maine and more northern waters during the summer and migrate south in the fall over the shelf to nesting beaches in South America.

The Atlantic ridley prefers shallow coastal waters and has been reported in coastal areas as far north as Nova Scotia (Ernst and Barbour, 1972). Lazelle (1976) states that the ridley is present in New England waters from July through November. Pritchard (1976) has suggested that the ridley also uses the Gulf Stream to migrate north from its only remaining known nesting beach in the Gulf of Mexico. As recently as 1963, the nesting population was estimated at 42,000 females; by 1975 it had declined to perhaps 500 (Carr and Mortimer, 1980).

Green sea turtles are uncommon visitors to the North Atlantic region. They are usually found in shallow coastal waters which support rooted aquatic vegetation, but they also migrate across the open seas. The hawksbill characteristically inhabits rocky areas, coral reefs, and shallow coastal habitats in temperate and tropical waters.

2. Coastal Resources

a. Birds

Coastal and nearshore avian resources in the North Atlantic region consist of three main groups: shorebirds, wading birds, and waterfowl. Shorebirds are a closely related group of species that is represented in the North Atlantic by oystercatchers, plovers, sandpipers, turnstones, yellowlegs, dowitchers, godwits, and phalaropes. Shorebirds are found in most marine, estuarine, and palustrine habitats where they feed mainly on aquatic invertebrates. They utilize these coastal areas during their northerly spring migration and southerly fall migration which actually begins in mid-summer.

Wading birds typically have long legs and necks with small bodies. Principle species include the herons, egrets, ibises, and bitterns. Wading birds feed in shallow water in marine and estuarine intertidal areas in every state bordering the North Atlantic. Nesting occurs in every state except New Hampshire, with New Jersey and Long Island, NY supporting the largest nesting populations (Table III.B.2.a-1). The breeding season can begin as early as late February or March and peaks in May and June. Most waterbird young have fledged by August (Erwin, 1979).

The coastal marshes, bays, sounds, and nearshore areas of the North Atlantic states (Visual #2) provide feeding and resting areas for large numbers of waterfowl that annually migrate through these areas during the spring and fall. The spring migration occurs from March to early May and the fall migration peaks between October and November. In addition, more than 450 thousand waterfowl usually winter in the coastal wetlands of the North Atlantic states with Massachusetts and New York supporting the densest populations (Gusey, 1977). A few of the major nearshore areas are off Monomoy Island, Nantucket Shoals, Nantucket Sound, Block Island Sound, Long Island Sound, and the waters off Montauk Point and the south shore of Long Island.

Table III.B.2.a-1. Nesting populations of seabirds and wading birds, by States, 1977.a

State	Seabirds	Wading birds	Total pairs
Maine	99,623	1,190	100,813
New Jersey	44,676	8,713	53,389
Massachusetts	39,922	2,566	42,488
New York (Long Island)	33,619	4,247	37,866
Rhode Island	7,193	1,026	8,219
Connecticut	4,961	506	5,467
New Hampshire	465	0	465
Totals	230,459	18,248	248,707

b. Estuaries, Wetlands, and Unique Habitats

Estuaries and coastal wetlands are highly productive and dynamic, yet very fragile habitats that support a great diversity of fish and wildlife species. Approximately two-thirds of the Atlantic's commercially valuable fish and shellfish stocks are estuarine dependent during some stage of their development. Waterfowl, shorebirds, wading birds, and birds of prey use coastal wetlands for breeding, feeding, migrating, and over-wintering. A variety of amphibian, reptilian, and mammalian species are common residents of coastal wetlands (FES Sale #42, Vol. I).

There are three major estuaries (Narragansett Bay, Raritan Bay, and Delaware Bay) and many smaller estuarine systems bordering the North Atlantic. Over 1 million acres of wetlands habitat are associated with these estuaries and portions of the Atlantic coast from New Jersey, north (Gusey, 1977). The states with the most extensive amounts of coastal wetland and estuarine zone habitat are New Jersey, New York (Long Island), Massachusetts, and Maine respectively. However, the U.S. Department of the Interior's National Estuary Study (1970) determined that the majority of the estuarine systems and coastal wetlands bordering the North Atlantic had been moderately or severely modified, with the noteable exception of the central and northern Maine coast, Cape Ann, MA, the eastern end of Long Island, and portions of the Gateway National Recreation Area located at the mouth of Raritan Bay. In addition to these relatively unmodified areas, numerous state and federal wildlife refuges and parks provide protection to valuable coastal wetlands (Visual #2). The first designated Estuarine Sanctuary on the Atlantic coast is located in Narragansett Bay, R.I.

In addition to wetlands, rocky shore and sandy beach/dune habitats are present along the North Atlantic coast. Rocky shorelines occur in several places along the New England coast but are most prevalent along the Maine shore. Exposed rocky shores support a dense and diverse assemblage of benthic invertebrates with the densities of some species ranging up to 160,000/m2 (Larsen and Berounsky, 1979). These invertebrates are an important food source for a variety of waterfowl and seabirds and to a lesser extent for harbor and gray seals (discussed in Section III.B.1.d).

Most of the ocean frontage in the North Atlantic region, excluding the coasts of Maine and New Hampshire, consists of sandy beach/dune areas. The dune areas found landward of the sandy beaches usually support a fragile dune grass or shrub community (Species listed in FES OCS Sale No. 42, Vol. I, p. 404). These plant communities are highly sensitive to stress-inducing factors such as water pollution or beach development. Seabirds, shorebirds, and waterfowl are the principle animal species that use beach/dune habitats.

Many remaining beach/dune areas in the North Atlantic region are currently protected by way of federal, state, or privately owned wildlife refuges and designated parks or national seashore (Shown on Visual #2).

c. Endangered Species and Species of Concern

The bald eagle (Haliaeetus leucocephalus) is an endangered species that is native to the North Atlantic coastal areas. A small group are known to overwinter in the vicinity of the Brigantine National Wildlife Refuge in New Jersey. However, the majority of birds nest (See Visual #2) or overwinter along the coast of Maine. Bald eagles nesting in Maine represent more than 90 percent of the known breeding population in the Northeastern United States (Fefer and Schettig, 1980). Eagles occur in the coastal zones of the remaining states briefly during migration periods.

There are two subspecies of the endangered peregrine falcon (Falco peregrinus) found in the region: F. p. anatum (American Peregrine) and F.p. tundrius (Arctic Peregrine). The Eastern Peregrine Falcon Recovery Team is currently attempting to reestablish a resident American peregrine falcon population in the Brigantine-Barnegat Bay area of New Jersey. To date, two nests from captive-released hybrids successfully fledged young in 1980. The Eastern U.S. population of this subspecies is considered to have been extripated in the early 1960's. The Arctic peregrine breeds in the North American tundra and migrates along the east coast where it is the most common of the two subspecies. During migration periods (September - November and February - March) peregrines use remote beach areas such as Block Island, Marthas Vineyard, and Parker River National Wildlife Refuge in Massachusetts to prey on a variety of shorebirds or to rest on open beach areas.

The Eskimo curlew (Numenius borealis) is an endangered species which formerly migrated through the North Atlantic coastal areas in the spring and fall. This bird has not been sighted for many years in the Eastern United States and is currently thought to be extirpated from this region.

The osprey (Pandion haliaetus) is not endangered or threatened, but it is a species of concern due to an overall decline in numbers along the Atlantic coast during the past 20 to 30 years. Ospreys are fish-eating birds that often nest and feed in protected bays and inlets of every coastal state except New Hampshire. The greatest concentration of ospreys in the North Atlantic region centers around the eastern end of Long Island and the seaward approaches to Long Island Sound.

None of the currently listed endangered plants are known to exist in the coastal regions of the North Atlantic states. Many species found in the North Atlantic coastal areas that had been proposed for endangered or threatened status were included in the 1,726 native species that were withdrawn from immediate listing considereation but remain under notice of review (Federal Register, December 10, 1979).

The shortnose sturgeon (Acipenser brevirostrum) is an endangered anadromous fish which has been recorded from the Connecticut, Hudson and Delaware Rivers. However, it is believed they inhabit every large river on the Atlantic coast that is not grossly polluted. At present, very little is known concerning the life history of this species, particularly when it enters the marine environment.

In addition to the Federal list of endangered and threatened species, several coastal states have also compiled lists of endangered fauna based on population and distribution information for each state rather than for a species' entire range. These lists are available from each individual state. They have been compiled and described in the Center for Natural Areas (1977) study.

3. Fisheries

Georges Bank is a complex and dynamic multi-community ecosystem. The composition and distribution of particular species are a function of many ecological factors including water chemistry, depth, bottom types, food availability and suitable spawning and nursery grounds.

Temperature is considered the single most important factor separating the primarily endemic northern species north of Cape Cod from the southern populations which consist primarily of migrant species. Georges Bank, a home for many resident fish and shellfish, becomes a seasonal destination for other migrant species. In addition, residents exhibit a localized inshore-offshore movement in response to seasonal temperature changes.

Food availability within specific areas may affect the distribution of offshore fish. Groundfish on Georges Bank are most numerous in areas with high macrobenthic population (Wigley, 1965). High concentrations of macrobenthic food organisms, and hence greater densities of groundfish, are found in Great South Channel, the northern periphery of Georges Bank, portions of the Gulf of Maine, and South of Cape Cod. Lower densities of groundfish are found in west central Gulf of Maine, and southwest and southeast Georges Bank (see Visual No.5).

Likewise, there are indications that prey density is directly related to food preference, and that while most fish feed upon a fairly wide range of organisms, the bulk of their diet is composed of only a few species (Tyler, 1972).

The following summaries of the life history information for ten important finfish and shellfish of the Georges Bank region are provided to describe the life cycles of representative species throughout the food chain, and their particular requirements that could be impacted by the proposed sale. Table III.B.3.a-1 lists the species selected and reasons for their inclusion. The exclusion of other species does not imply lesser importance, but similar life cycles to the species discussed. Pollack, with few minor differences, has a life history similar to cod and haddock. Likewise, menhaden are similar to sea herring. Concerns for certain life stages such as pelagic eggs and larvae would be applicable to all species having similar life stages on Georges Bank.

Table III.B.3.a-1. Ten Representative Finfish and Shellfish Species and their Selection Criteria

A. BLUEFISH	A. IMPORTANT COASTAL SPORT-FISHERY; PISCIVORE; SUMMER MIGRANT IN NEW ENGLAND.
B. SILVER HAKE	B. IMPORTANT COMMERCIAL SPECIES ON GEORGES BANK; PISCIVORE, PELAGIC DISTRIBUTION; SPAWNS PELAGIC EGGS ON GEORGES BANK.
C. BLACKBACK FLOUNDER	C. IMPORTANT COMMERCIAL SPECIES; OMNIVORE; DEMERSAL DISTRIBUTION, SPAWNS DEMERSAL EGGS INSHORE.
D. SEA HERRING	D. IMPORTANT COMMERCIAL SPECIES; PLANKTIVORE; PELAGIC DISTRIBUTION; SPAWNS DEMERSAL EGGS ON GEORGES BANK.
E. HADDOCK	E. IMPORTANT COMMERCIAL SPECIES; OMNIVORE (BENTHIC ORGANISMS); DEMERSAL DISTRIBUTION, SPAWNS PELAGIC EGGS.
F. ATLANTIC COD	F. IMPORTANT COMMERCIAL GROUNDFISH ON GEORGES BANK; OMNIVORE;PELAGIC EGGS AND LARVAE.
G. YELLOWTAIL FLOUNDER	G. IMPORTANT COMMERCIAL GROUNDFISH IN PROPOSED LEASE SALE 52 REGION; OMNIVOROUS; DEMERSAL DISTRIBUTION; SPAWNS PELAGIC EGGS.
H. SEA SCALLOP	H. IMPORTANT COMMERCIALLY-HARVESTED SHELLFISH ON GEORGES BANK; DEMERSAL DISTRIBUTION; PELAGIC EGGS AND LARVAE.
I. OCEAN QUAHOG	I. POTENTIAL COMMERCIAL SPECIES ON GEORGES BANK; DEMERSAL; PELAGIC EGGS AND LARVAE.
J. AMERICAN LOBSTER	J. IMPORTANT COMMERCIAL HARVEST WITHIN PROPOSED LEASE SALE 52 REGION; DEMERSAL DISTRIBUTION; EGGS BROODED; FREE-SWIMMING LARVAE.

Bluefish, *Pomatomus saltatrix*

The blue fish is a warm season migrant ranging the east coast from South America to its northern limit off Massachusetts. Annual north-south migrations along the Atlantic are related to the seasonal warming and cooling of coastal waters. Schools of bluefish first arrive off southern New England in April and May when temperatures reach 53.6° to 59°F. In the Gulf of Maine, they appear to be limited to the nearshore regions and western portions of Georges Bank. Bluefish return to the outer shelf for spawning from May to June in offshore waters out to the edge of the shelf in waters warmer than 59°F. By late July or August post-spawning adults have returned to the inshore feeding grounds. Bluefish are highly valued by anglers as an excellent sports fish and are fished heavily in coastal waters of southern Massachusetts. Bluefish are occasionally taken by surface gill nets, but are of little importance to commercial fishermen.

Silver hake, *Merluccius bilinearis*

Silver hake centers of abundance are the inshore waters of the Middle and North Atlantic coast, particularly the southwestern part of the Gulf of Maine and the southern edge of Georges Bank (see Visual No. 5). The silver hake is a voracious predator feeding on the young of herring, menhaden, alewife, mackerel, smelt, squid, euphausids, etc. Because of its pelagic habits, hake is caught indifferently over sand, pebbles, and mud, but seldom over broken bottom types such as rocks (Bigelow and Schroeder, 1953).

Because silver hake prefer relatively warm waters (42.8-46.4°F), they migrate seasonally from wintering grounds to spawning grounds. They overwinter along the continental slope and in the deep basins, moving into shallower regions during the summer for spawning and return to deeper water in autumn (Hare, 1977). Spawning occurs in late spring and early summer along the entire coastal zone from Cape Cod to Grand Manan Island, Canada, in waters typically less than 50 fathoms, but occasionally to depths of 150 fathoms (Bigelow and Schroeder, 1953). Important spawning regions are the northeast and southern Georges Bank (see Visual No.5) and the Central Gulf of Maine, spawning occurs from June through October, peaking in July and August on Georges Bank (Colton *et al.*, 1979). Hake eggs are buoyant with a rapid incubation period of 48 hours. Juveniles move into deeper water at the end of their first summer and remain during the following year.

Primary fishing grounds for silver hake (whiting) are along the inshore regions of the Mid- and North Atlantic coasts and on Georges Bank. Gear routinely used include the otter trawl, longlines, and gill nets set on the bottom. New England has experienced a steady decrease in domestic landings since 1957 to early 1970's. Catches in recent years by the U.S. fleet have been less than 45 million pounds annually. Sixteen million pounds of silver hake were landed in New England during 1979 (Table III.B.3.a-2).

Table III.B.3.a-2 New England 1979 Commercial Landings by Weight and by Dollar Value for the Top Twenty Species of Finfish and Shellfish.

RANK	BY WEIGHT SPECIES	LBS	RANK	BY DOLLAR VALUE SPECIES	$
1	SEA HERRING	142,989,486	1	LOBSTER	61,399,358
2	COD	96,025,431	2	SEA SCALLOPS	54,927,306
3	MENHADEN	59,048,870	3	COD	27,838,766
4	HADDOCK	40,672,132	4	HADDOCK	17,206,221
5	OCEAN PERCH	34,024,944	5	YELLOWTAIL	17,198,971
6	YELLOWTAIL	34,005,376	6	SEADAB	9,091,849
7	POLLOCK	33,106,891	7	BLACKBACK	8,998,197
8	LOBSTER	32,330,884	8	SEA HERRING	8,364,227
9	SEADAB	23,644,319	9	SOFT CLAMS	8,330,237
10	BLACKBACK	22,072,137	10	HARD CALMS	7,899,380
11	SEA SCALLOP*	16,175,871	11	SWORDFISH	7,237,493
12	WHITING	16,108,234	12	OCEAN PERCH	7,161,614
13	SQUID (COMBINED)	9,521,867	13	POLLOCK	6,379,627
14	SHARKS	8,903,778	14	GRAY SOLE	3,718,190
15	SCUP	8,586,764	15	BLUEFIN TUNA	3,228,648
16	SOFT CLAMS*	5,588,528	16	FLUKE	2,919,002
17	GREY SOLE	5,333,505	17	WHITING	2,738,062
18	SWORDFISH	4,600,279	18	SQUID (COMBINED)	2,830,189
19	ANGLERFISH	3,987,796	19	SCUP	2,613,123
20	FLUKE	3,951,709	20	ANGLERFISH	1,787,740

*Meat weights

Source: 1) NOAA, 1979 (State Landings, Monthly Summaries, 1979)

Blackback Flounder, Pseudopleuronectes americanus

The blackback flounder occurs in coastal waters and on offshore banks from Newfoundland to Cape Hatteras. Although it is a predominantly shallow water species preferring a substrate of sandy clay or pebbles, it is also found offshore in deeper waters on hard bottoms.

Spawning occurs from January to May primarily inshore in shallow waters on sandy bottoms but also on Georges Bank and Nantucket Shoals. The eggs are demersal and stick in clusters. Flounder larvae and fry feed on diatoms, isopods, amphipods, crabs, shrimp and annelids. Adults feed on ascidians, clam siphons and molluscs.

The movements of the adult flounders are restricted to inshore seasonal migrations. Movement to shoal breeding areas during late fall and winter is followed by a dispersal into deeper offshore waters as inshore temperatures increase. Apart from the seasonal movements mentioned, the adult flounder is relatively stationary (Saila and Pratt, 1973).

Blackback flounder are harvested primarily from the near-shore zone, in the Great South Channel, and along the western edge of Georges Bank (MCZM, 1980) (see Visual No. 5).

Atlantic herring, Clupea harengus

Herring, an open water fish, are not substrate selective other than for spawning (see Visual No. 5). As with many species, food preferences change with growth, and adults feed primarily on crustaceans such as copepods, amphipods and euphausiids. Of the commercially important species inhabiting Georges Bank, the herring and menhaden are the only pelagic species exhibiting planktivorous feeding habits.

Herring exhibits, a spawning trend unlike other Georges Bank species (except summer flounder), commencing in the norther portion of the Atlantic and progressing southward (TRIGOM, BLM ESP). Herring may spawn in spring, summer or autumn, according to locality on Georges Bank. Spawning occurs primarily from mid-September through November (Colton et al., 1979) along shores in the Gulf of Maine and on various offshore shoals and ledges. Spawning locations are distributed in small clusters over Georges Bank. Nantucket and Cultivator Shoals are minor spawning regions, and the northern edge of Georges Bank is a major spawning area (Hare, 1977; Colton et al., 1979). Herring is the only commercially important species which spawns demersal eggs on Georges Bank .

New England landings were 143 million pounds in 1979, making the Atlantic herring New England's most important species by weight (finfish and shellfish). However, at $8,364,227 it represents New England's eighth most valuable species (Table III.B.3.a-2).

Haddock, Melanogrammus aeglefinus

The haddock is distributed from Newfoundland's Grand Banks to southern New England. On Georges Bank they are distributed along the northern edge as well as in deeper sloughes along the western portions of the Bank through the Great South Channel to Nantucket Shoals.

Haddock are predominantly cold-water groundfish which exhibit seasonal differences in depth distribution. In spring and summer they spread into shallow warmer water of the banks but leave when temperatures rise above 50-52°F (Bigelow and Schroeder, 1953). In the winter they desert the open banks and move again into deeper water. The haddock are found mostly at depths of 50-150 meters, rarely being caught in depths less than 10-20 meters or greater than 200 meters (See Visual No. 5).

Haddock may spawn anywhere on the Bank east of Nantucket shoals, but the major spawning grounds lie along the northern edge and northeastern peak of the Bank and east of Cape Cod (Bigelow and Schroeder, 1957). Spawning takes place from February to April when water temperature is between 36 and 43°F (Colton et. al., 1979). The eggs are buoyant and float at the surface. Hatching occurs in 15 days at 37°F. The larvae are pelagic and drift in the intermediate and upper water layers for considerable distances

from the spawning grounds. Juveniles are pelagic for several months but seek the bottom at depths of 20-50 fathoms as early as July or as late as September. Adults are demersal and are substrate-selective, preferring a rough bottom of gravel, pebbles, and gritty sand with broken shell (Bigelow and Schroeder, 1953).

Adults are constantly on the move searching for food and feeding indiscriminately on molluscs, crabs, shrimp, annelids, starfish, sea urchins, and sand dollars (Bigelow and Schroeder, 1953). Leim and Scott (1966) reported that haddock caught on the banks showed a preference for fish as food, especially the sand lance (*Ammodytes*). Annelids constituted about 10% of the food of the bank haddock.

The most important fishing grounds for haddock in the North Atlantic are along the northern edge, the central and southeastern portions of Georges Bank, Great South Channel, and Nantucket Shoals (MCZM, 1980) (See Visual No. 5). Gear routinely used to capture haddock include the otter trawl, longlines up to several miles long with several thousand hooks, and gill nets set on the bottom.

Georges Bank haddock fishing was almost exclusively American until the 1960's when Canadian, USSR and other foreign vessels started fishing on Georges Bank. A successful year class in 1963 was subjected to extremely heavy fishing in 1965 and 1966, largely by the Soviet fishing fleet. Total catches increased to a peak of 330 million pounds in 1965 by all countries but subsequently have declined (Shell, 1977). Haddock landings have fluctuated between 12.8 and 17.2 million pounds in recent years. There were 40.7 million pounds landed by New England fishermen in 1979, less than 1% increase from 1978. The 1979 landings were valued at $17.2 million, a 30% increase over 1978. (Table III.B.a-2).

Atlantic cod, *Gadus morhua*

The Atlantic cod ranges over most of the North Atlantic from Labrador to New Jersey. The northeastern edge of Georges Bank is an extremely productive area. Great South Channel, Nantucket Shoals and Browns Bank are also productive areas for cod (see Visual No. 5).

Cod occur from shallow, inshore waters down to depths of 260 fathoms, although most are found at depths from 5 to 75 fathoms. Cod are usually found within a few fathoms of the bottom sand or gravel; it is seldom found over soft mud substrates. Their diet is size-dependent and adult cod feed primarily on invertebrates such as molluscs, tunicates, squid and small fish.

Movements of cod on and offshore are related to temperature preference, search for proper spawning conditions, and presence or absence of food (Idler and Jangaad, 1969).

On Georges Bank, spawning occurs from December to April with peak spawning in March (Colton *et al.*, 1979) (see Visual No. 5). Large quantities of cod spawn on the eastern part of Georges Bank (Shell, 1977). Fertilized cod eggs are buoyant and remain pelagic for 10-50 days before hatching. They are present in the water column from January to June on Georges Bank and the Gulf of Maine.

The most recent assessments indicate that Georges Bank cod biomass is at a relatively high level. On a short term basis, harvest at 1978 levels appear to be sustainable (NMFS, 1979). During 1979, 96 million pounds of cod valued at $27.8 million were landed in New England (Table III.B.3.a-2).

Yellowtail Flounder, Limanda ferruginea

Yellowtail are abundant in the general region of Nantucket shoals, the Great South Channel and the western half of Georges Bank. Yellowtail are also found on the eastern end of the Bank but in lower concentrations. Southeast Georges Bank has been a consistently excellent producer of flounder, including yellowtail and is a major yellowtail fishing region (see Visual No. 5).

The yellowtail is distributed deeper than the winter flounder with most being found at depths of 40-100 meters, but rarely deeper than 100-120 meters. Yellowtail prefers a bottom of sand or a sand/mud mixture (Bigelow and Schroeder, 1953).

Adults feed chiefly on small crustaceans such as amphipods, shrimp, mysids and small shellfish. Yellowtail are spring spawners, beginning as early as March and lasting through July (Colton et al., 1979). Major spawning areas include the Isle of Shoals and Boars Head at 40-60 meters, Stellwagen Bank, and the western and northwestern periphery of the Gulf of Maine, between 40-100 meters (Bigelow and Schroeder, 1953). Eggs and larvae are pelagic and develop in offshore waters between March and August (Bigelow and Schroeder, 1953).

Georges Bank catches have declined during the 1970's to the present level which is 42% below the 1935-1978 average (NMFS, 1979). The yellowtail flounder fishery accounts for an important portion of the New England commercial fish harvest. It currently ranks sixth in importance of New England catch weight and fifth by value. (Table III.B.3.a-2).

Sea Scallop, Placopecten magellanicus

The Atlantic sea scallop is distributed on the continental shelf from the Gulf of St. Lawrence to Cape Hatteras. The most productive scallop areas on Georges Bank are the Great South Channel, the northern edge, and less consistently, the southeast portion (Serchuk et. al., 1979) (see Visual No. 5). On Georges Bank, scallops are associated with rough bottoms of poorly sorted gravel, rocks, boulders and shells. Temperature seems to be the controlling factor determining scallop distribution. Sea scallops prefer cold water with an optimum temperature of about 50°F and are intolerant of temperatures in excess of 72°F. Northern scallop stocks prefer shallower water (20m) and more southern stocks are found in deeper waters (55m), although scallops exist to depths of 100 m.

Spawning occurs in late summer and early fall (Serchuk et. al., 1979). Great South Channel and the northern edge of Georges Bank are the major spawning areas. Sea scallop eggs and larvae are buoyant and remain free swimming in surface layers for several weeks before settling. Once settled, adult scallops maintain a demersal life as filter feeders with a diet consisting of diatoms and detrital material.

While traditional scallop grounds have been on Georges Bank, in recent years emphasis has shifted to the Mid-Atlantic beds located near the Hudson Canyon and off the Virginia Capes. Landings along the Atlantic coast have gone up sharply since 1976 because of increased landings from the Mid-Atlantic grounds.

Ocean Quahog, Arctica islandica

In the Gulf of Maine and the vicinity of Cape Cod, quahogs are typically nearshore residents found in depth out to 30 fathoms (Allen et. al., 1976). Quahogs also occur on southern Georges Bank (see Visual No. 5) and along the edge on the shelf nearly to its northeastern tip along the 50 fathom contour (Merril and Ropes, 1969). Ocean quahog are most common on soft bottoms in silty-sand and stable fine sand. Spawning occurs from late June or early July until October. Larvae are planktonic for an extended period of time (60 days at 50°F) before settling to the substrate.

A major factor contributing to the increase of commercial harvesting of ocean quahogs has been development of a fishery off New Jersey in 1976 and the Delmarva Peninsula in 1977. Limited sampling on Georges Bank confirms the presence of quahogs, but the frequent large boulders north and east of Cape Cod makes the fishing gear prone to damage (Murawski and Serchuk, NMFS, unpublished manuscript).

American lobster, Homarus americanus

The American lobster ranges from Labrador to North Carolina. In southern New England, lobster are found subtidally to the continental slope. There is a valuable fishery on the southern and outer portions of Georges Bank primarily near the submarine canyons at 60-300 fathoms (Allen et al., 1976) (see Visual No. 5). Populations are generally segregated into offshore and inshore groups, with offshore stocks concentrated between the 50 and 250 fathom contour at 60 to 200 miles from shore. Though coastal populations remain localized and subject to wide termperature extremes, Saila and Flowers (1968) found that offshore lobsters migrate extensively to remain in regions of optimal temperatures.

Lobster mate from March through June just after molting of the female. The female carries the fertilized eggs from 10 to 12 months. Lobster larvae hatch in the summer and remain planktonic, drifting in the near-surface currents for 10-30 days before settling to the bottom.

Lobster are harvested primarily in a region paralleling the 100 m contour from southern Georges Bank southwest along the New England coast. There are several smaller lobster fishing regions along the western and northern edges of the bank, as well as the north-central portion of the bank. Lobsters are caught primarily with traps set on the bottom on lines up to a mile long; they are also taken with otter trawls.

Annual offshore catches in the Georges Bank-Southern New England region increased gradually from 192,000 pounds in 1951 to a peak of 8.8 million pounds in 1972, and subsequently stabilized at approximately 5.7 million pounds per year during 1974-1978, with Georges Bank accounting for 32% of the catch (NMFS, 1979).

a. Commercial Fishing

The Georges Bank region, encompassing approximately 70,000 km2, produces an annual harvest of 25.6 thousand lbs/km2 (MCZM, 1980). In 1979, over 30.2 million pounds of finfish and shellfish were harvested from Georges Bank by New England fishing vessels; this catch was valued in excess of $121 million (NMFS, unpublished data) (Table III.B.3.a-2).

The New England seaboard states (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) have a commercial fishery (inshore as well as offshore) whose combined landings by volume and value rank as the third most important in the U.S. (NMFS, 1980). The Pacific coast and Alaska ranked first and the Gulf States second in value. (By landings, the Gulf States were first, followed by the Pacific coast and Alaska).

Commercial Fisheries of Seaboard States and Ports

Massachusetts has been New England's historical leader in both volume and value of finfish and shellfish harvested. In 1979, 363 million pounds were harvested by Massachusetts fishermen; this catch was valued at $166 million dollars and constituted 53% and 59% of the total New England commercial landings by weight and value, respectively. Primary commercial species and their contribution are listed in Table III.B.3.a-3).

The Massachusetts commercial fishing industry relies more heavily on Georges Bank than any other New England State (NMFS, 1979). Landing for 1979 indicated that 91% of the sea scallops, 86% of the haddock, 77% of the blackback flounder, 70% of the yellowtail, 56% of the ocean perch, 51% of the pollock, 40% of the swordfish and 29% of the cod harvested by Massachusetts fishermen were caught on Georges Bank. In contrast only 17% of the lobsters landed by the Massachusetts fleet were caught on Georges Bank.

Gloucester, Boston, New Bedford and Provincetown are the major fishing ports, but smaller towns such as Chatham, Plymouth and Sandwich also play an important role in the fishing industry. In 1979, Gloucester landings were 160 million pounds, or 44% of the total Massachusetts harvest by weight. These landings were valued at $30 million or 18% of the total Massachusetts fisheries value. Gloucester's most valuable species harvested on Georges Bank include haddock, cod, pollack, ocean perch, and sea dab. Seventy-nine percent of the sea scallops, 89% of the lobster and 100% of the swordfish landed in Gloucester are caught on Georges Bank.

New Bedford is Massachusett's leading port in value of fish landed and second in total weight. The primary species landed in New Bedford are caught almost entirely on Georges Bank; 93% on New Bedford's total industry by value was harvested on Georges Bank (NOAA, 1979).

Table III.B.3.a-3 Massachusetts 1979 Commercial Landings by Weight By Dollar Value for Top Twenty Species of Finfish and Shellfish.

BY WEIGHT RANK	SPECIES	LBS	BY DOLLAR VALUE RANK	SPECIES	$
1	COD	81,551,849	1	SEA SCALLOPS	48,345,865
2	SEA HERRING	50,789,715	2	COD	23,961,807
3	HADDOCK	33,491,434	3	LOBSTER	16,405,038
4	MENHADEN	29,040,640	4	HADDOCK	14,277,458
5	YELLOWTAIL	22,932,330	5	YELLOWTAIL	12,075,614
6	POLLOCK	19,817,493	6	BLACKBACK	6,522,819
7	OCEAN PERCH	16,184,813	7	SWORDFISH	5,861,581
8	BLACKBACK	15,310,060	8	SEADAB	4,733,447
9	SEA SCALLOPS*	14,247,877	9	POLLOCK	4,047,646
10	SEADAB	11,589,402	10	OCEAN PERCH	3,626,152
11	LOBSTER	7,929,437	11	SEA HERRING	3,585,748
12	WHITING	7,631,382	12	BLUEFIN TUNA	3,220,587
13	SQUID (COMBINED)	6,884,213	13	GREY SOLE	2,126,132
14	SHARKS	6,546,409	14	SQUID (COMBINED)	1,880,125
15	SWORDFISH	3,697,256	15	HARD CLAMS	1,551,965
16	GREY SOLE	3,530,150	16	WHITING	1,387,537
17	RED HAKE	3,342,525	17	BAY SCALLOPS	1,356,693
18	SAND FLOUNDER	2,709,546	18	ANGLERFISH	1,159,722
19	RED CRAB	2,667,664	19	RED CRAB	907,729
20	ANGLERFISH	2,609,399	20	LEMONSOLE	865,435

Source: 1) NOAA, 1979 (STATE LANDINGS, MONTHLY SUMMARIES, 1979)

*MEAT WEIGHTS

Boston is Massachusett's third major port in both weight and value of fish landed. The harvest of haddock, cod, ocean perch, pollack and sea dab from Georges Bank was responsible for 78% of the total value of fish and shellfish landed. The harvest of offshore sea scallops and lobster is largely dependent on Georges Bank.

Fishery landings for Provincetown, Sandwich, Plymouth and Chatham are all dependent to a large extent on Georges Bank for their fishing industry, particularly for yellowtail, blackback, swordfish, sea scallops and lobsters.

Maine has the second largest commercial fishing industry in New England, with a total 1979 harvest of 232 million pounds valued at $80.3 million dollars (Table III.B.3.a-4). NMFS statistics indicate that less than 1% of Maine's catch was taken from Georges Bank (Coastal Resource Center, 1976). Traditionally, Maine fishermen work inshore grounds from small vessels and boats. Larger vessels from Portland and Rockland fish farther offshore, but

Georges Bank still contributes only a small percentage to their catches. Of Maine's most valuable species (Table III.B.3.a-4), 1% of the sea dab, pollack, and grey sole, 12% of the ocean perch, 9% of the cod, 27% of the haddock, and 33% of the sea scallops landed were from Georges Bank. No lobster, soft clams, or sea herring (the three most valuable species) were harvested from the Bank by Maine fishermen. With the exception of swordfish, Maine's commercial fishing industry relies only minimally on Georges Bank.

Table III.B.3.a-4. Maine 1979 Commercial Landings By Weight and by Dollar Value for the Top Twenty Species of Finfish and Shellfish

BY WEIGHT			BY DOLLAR VALUE		
RANK	SPECIES	LBS	RANK	SPECIES	$
1	SEA HERRING	89,375,145	1	LOBSTER	39,900,632
2	MENHADEN	30,005,240	2	SOFT CLAMS	7,507,899
3	LOBSTER	22,133,235	3	SEA HERRING	4,583,641
4	OCEAN PERCH	17,836,557	4	SEADAB	4,170,677
5	POLLOCK	13,139,603	5	SEA SCALLOPS	3,878,413
6	SEADAB	11,641,292	6	OCEAN PERCH	3,534,320
7	COD	10,365,746	7	COD	2,598,386
8	HADDOCK	6,247,339	8	HADDOCK	2,592,021
9	SOFT CLAMS*	5,193,313	9	POLLOCK	2,304,685
10	GREY SOLE	2,656,918	10	GREY SOLE	1,524,651
11	SHARKS	2,348,656	11	BLOODWORMS	1,434,258
12	ALEWIVES	2,304,728	12	SANDWORMS	1,109,292
13	MUSSELS	2,000,472	13	MENHADEN	759,979
14	SEA SCALLOPS*	1,163,645	14	MUSSELS	716,128
15	CUSK	1,467,305	15	SWORDFISH	630,576
16	ROCK CRABS	1,344,179	16	ANGLERFISH	338,954
17	BLACKBACK	966,036	17	BLACKBACK	302,972
18	SEAWEED	890,000	18	CUSK	286,106
19	SANDWORM	744,400	19	ROCK CRAB	213,616
20	ANGLERFISH	729,560	20	YELLOWTAIL	168,020

Source: 1) NOAA, 1979 (STATE LANDINGS, MONTHLY SUMMARIES, 1979)

*MEAT WEIGHTS

Portland and Rockland are Maine's primary commercial fishing ports; having commercial landings of 59.6 and 41.8 million pounds of fisheries products in 1979 (NOAA, 1979). The fisheries for sea scallop, haddock, ocean perch, cod, and swordfish are somewhat dependent on Georges Bank. The sea scallop fishery in particular relies on Georges Bank, with 68% of Portland's landings and 80% of Rockland's scallop landings for 1979 coming from Georges Bank.

Rhode Island eighty-eight million pounds of finfish and shellfish were harvested by Rhode Island fishermen during 1979. This catch was valued at $36 million and contributed 13% of the total New England catch (Table III.B.3.a-5).

Table III.B.3.a-5. Rhode Island 1979 Commercial Landings by Weight and Dollar Value for the top Twenty Species of Finfish and Shellfish.

BY WEIGHT RANK	SPECIES	LBS	BY DOLLAR VALUE RANK	SPECIES	$
1	YELLOWTAIL	10,641,975	2	HARD CLAMS	6,345,215
2	WHITING	8,333,621	2	LOBSTER	5,093,688
3	MENHADEN	7,388,620	3	YELLOWTAIL	4,955,337
4	SCUP	6,885,307	4	SEA SCALLOP	2,703,028
5	BLACKBACK	5,796,041	5	BLACKBACK	2,172,406
6	COD	4,107,836	6	FLUKE	2,052,737
7	BUTTERFISH	3,813,336	7	SCUP	2,039,283
8	OCEAN QUAHOG*	2,949,021	8	WHITING	1,335,197
9	FLUKE	2,824,676	9	BUTTERFISH	1,288,638
10	SEA HERRING	2,824,672	10	COD	1,278,573
11	SQUID (COMBINED)	2,618,144	11	SQUID (COMBINED)	946,840
12	LOBSTER	2,268,172	12	OCEAN QUAHOG	921,906
13	HARD CLAMS	2,186,277	13	SWORDFISH	745,336
14	TILEFISH	952,734	14	BAY SCALLOPS	640,851
15	HADDOCK	933,359	15	SURF CLAMS	356,378
16	MACKEREL	790,388	16	HADDOCK	336,742
17	SEA SCALLOPS*	764,349	17	ANGLERFISH	289,064
18	ANGLERFISH	648,837	18	MACKEREL	229,335
19	SURF CLAM	644,778	19	TILEFISH	221,528
20	SAND FLOUNDER	561,244	20	LEMONSOLE	213,981

Source: 1) NOAA, 1979 (STATE LANDINGS, MONTHLY SUMMARIES, 1979)

*MEAT WEIGHTS

None of the hard clams landed in Rhode Island during 1979 were caught on Georges Bank. Similarly, only 1% of the scup, 2% of the whiting, and 5% on the butterfish were obtained on Georges Bank. Other species are harvested largely on Georges Bank; 33% on the blackback flounder, 43% of the lobster and fluke, 47% of the yellowtail, 58% of the sea scallops, and 64% of the cod landed during 1979 were harvested on Georges Bank.

Newport and Point Judith are Rhode Island's primary commercial fishing ports and accounted for 84% of the state's total landings for 1979. Lobster, yellowtail, sea scallops, blackback flounder and cod captured on Georges Bank represented 57% of Newport's total fishery landings for 1979. In contrast, Point Judith's landings are not heavily dependent on Georges Bank. Yellowtail, swordfish and fluke captured on the Bank during 1979 accounted for 8% of Point Judith's total industry value. Swordfish is the principal species harvested on Georges Bank that is landed at Point Judith.

New York and New Jersey are not New England states, but they are important contributors to the commercial fishing industry of the North Atlantic coast. The primary species harvested are ocean quahogs, sea scallops, hard clams, surf clams, oysters and whiting (Tables III.B.3.a-6 and III.B.3.a-7). New Jersey was the U.S. leading producer of surf clams and ocean quahogs in 1979 (NMFC, 1980), but they are primarily harvested in the Mid-Atlantic Bight. Hard clams and oysters are New York's most valuable species (Table III.B.3.a-6) and these shellfish are harvested in the coastal regions and not on Georges Bank.

Table III.B.3.a-6. New York 1979 Commercial Landings by Weight and by Dollar Value for the Top Twenty Species of Finfish and Shellfish.

BY WEIGHT			BY DOLLAR VALUE		
RANK	SPECIES	LBS	RANK	SPECIES	$
1	WHITING	6,285,369	1	HARD CLAMS	17,564,063
2	HARD CLAMS*	5,729,644	2	OYSTERS	4,331,125
3	SCUP	3,135,005	3	LOBSTER	1,851,609
4	TILEFISH	2,761,782	4	SEA SCALLOPS	1,827,199
5	SQUID (COMBINED)	1,794,861	5	TILEFISH	1,716,715
6	BLUEFISH	1,611,384	6	SCUP	1,557,847
7	SURF CLAMS*	1,550,900	7	BAY SCALLOPS	1,243,365
8	SEA TROUT	1,511,600	8	WHITING	1,166,028
9	BLACKBACK	1,465,840	9	FLUKE	1,161,377
10	FLUKE	1,426,551	10	STRIPED BASS	864,602
11	OYSTERS*	1,354,900	11	SQUID (COMBINED)	720,533
12	RED HAKE	1,062,618	12	SURF CLAM	675,672
13	BUTTERFISH	1,019,988	13	SEA TROUT	587,950
14	YELLOWTAIL	804,422	14	BLACKBACK	494,419
15	LOBSTER	702,058	15	BUTTERFISH	451,517
16	MACKEREL	695,526	16	BLUEFISH	406,555
17	MENHADEN	684,543	17	YELLOWTAIL	311,357
18	SEA SCALLOPS*	535,476	18	MACKEREL	249,444
19	STRIPED BASS	535,079	19	COD	244,267
20	COD	480,099	20	SWORDFISH	221,815

Source: 1) NOAA, 1979 (STATE LANDINGS, MONTHLY SUMMARIES, 1979)

*MEAT WEIGHTS

Table III.B.3.a-7. New Jersey 1979 Commercial Landings by Weight and by Dollar Value for the Top Twenty Species of Finfish and Shellfish.

BY WEIGHT RANK	SPECIES	LBS	BY DOLLAR VALUE RANK	SPECIES	$
1	OCEAN QUAHOG*	24, 968,070	1	SEA SCALLOPS	16,889,804
2	SURF CLAMS*	12,324,844	2	OCEAN QUAHOG	7,494,454
3	WHITING	11,749,247	3	SURF CLAM	6,302,279
4	SCUP	7,759,474	4	FLUKE	3,931,569
5	SEA TROUT	6,519,096	5	TILEFISH	2,550,994
6	FLUKE	6,278,700	6	OYSTERS	2,362,590
7	SEA SCALLOPS*	5,237,112	7	LOBSTER	1,727,236
8	TILEFISH	4,343,727	8	WHITING	1,718,191
9	RED HAKE	2,029,816	9	HARD CLAMS	1,566,882
10	MENHADEN	1,925,466	10	SCUP	1,514,242
11	OYSTERS*	1,675,411	11	SEA TROUT	901,979
12	BLUEFISH	1,578,615	12	SEA BASS	370,729
13	MACKEREL	1,213,679	13	CRABS (COMBINED)	353,036
14	ANGLERFISH	943,509	14	SWORDFISH	334,634
15	HARD CLAMS*	898,310	15	RED HAKE	251,033
16	CRABS (COMBINED)	885,300	16	BLUEFISH	232,168
17	LOBSTERS	805,691	17	SQUID	219,112
18	SHARKS	739,562	18	SOFT CLAMS	208,144
19	SEA BASS	600,404	19	BUTTERFISH	196,120
20	BUTTERFISH	574,213	20	MACKEREL	160,735

Source: 1) NOAA, 1979, (STATE LANDINGS, MONTHLY SUMMARIES, 1979)

*MEAT WEIGHTS

b. Sport Fishery

The sport fishery of New England has been described in the FEIS for Sale No. 42 and Shell (1977). There is practically no sport fishing occurring on Georges Bank (Jensen, 1973). Recreational fishing accounts for approximately 40% of the total U.S. finfish harvest that is used for food (NMFS, 1980). For some species, such as bluefish, the recreational catches even exceed the commercial harvest. However, one large difference between the commercial and sport fisheries is that virtually all of the sport fishing regions of New England are within 50 miles of shore. The proposed sale area is a minimum of 86 miles from shore. Species that are commonly sought by both the recreational and commercial fisheries in the Northeast include flounder, scup, bluefish, striped bass, Atlantic mackerel, cod, haddock, bluefin tuna, white marlin, and swordfish.

Foreign Fishing

Foreign fishing is conducted in the proposed sale area under the provisions of the Fishery Conservation and Management Act of 1976. Foreign fishing countries are allowed to catch hake, squid, Atlantic mackerel, river herring and butterfish. Foreign fishing areas are shown on Visual No. 5. Regulation of the foreign fishing in the North-Atlantic comes under the purview of the North Atlantic Fishery Management Council. The portion of the "optimum yield" which the U.S. is capable of harvesting and processing is assigned to the U.S. fishermen. The remainder is distributed among those foreign fishing countries which have developed agreements with the U.S. under the provisions of the Fishery Conservation and Management Act of 1976. In addition to the imposition of quotas, other restrictions include 1) fish size 2) fishing gear 3) fishing area and 4) season.

Fish Eggs and Larvae

Colton et. al. delineated principal spawning areas and times of common marine fish from Cape Sable, Nova Scotia to Cape Hatteras, North Carolina. Surveys (conducted by NMFS) are providing current information on species composition and seasonal and spatial distribution of ichthyoplankton on the New England Shelf.

Spawning activity is greatest for most species from late winter to mid-summer and often progresses northward with seasonally increasing temperatures (Bigelow and Schroeder, 1953). The vertical distribution of eggs and larvae within the water column and habitat characteristics of adults in relation to spawning is presented for common marine species in Table III.B.3.b-1.

Cape Cod has been identified as a transition zone for northern and southern species of fish (Colton et. al. 1979), resulting largely from a division in the physical/chemical characteristics of water east and west of this land mass. Colton et. al. (1979) point out that there is a marked difference in fish species composition and abundance between the two regions; boreal, non-migratory species dominate in the Gulf of Maine, while warm-water, migratory species prevail in the Middle Atlantic Bight. These authors also indicated that many species of fish were limited in their spawning activity to areas east of Nantucket Shoals (e.g. haddock pollock, redfish) or west of the shallow area (e.g. bluefish, menhaden, anchovies). Visual No. 5 shows the most important spawning areas in relation to the proposed Sale Area. Species composition and relative abundance of fish larvae monitored in coastal-offshore and estuarine surveys were presented in TRIGOM (1974). Surveys conducted in the offshore Gulf of Maine and Georges Bank waters Marak and Colton, 1961; Marak et al., 1962a, b; ERCO, 1978) have recorded up to 41 species of larvae and 16 species of eggs. The most common were haddock, cod, sand lance, Atlantic herring, yellowtail flounder, American plaice, mackerel, hake, silver hake, and winter flounder. Georges Bank is the most important spawning area for the commercially important haddock and Atlantic cod (see Visual No. 5), and consequently larval abundance is

Table III.B.3.b-1. Vertical Distribution of Eggs and Larvae within the Water Column and Clasification of Adults in Terms of Habitat Requirements for Spawning.

EGG AND LARVAL TYPE	SPECIES	ADULT CLASSIFICATION*
EGGS AND LARVAE PLANKTONIC	ATLANTIC MACKEREL	4
	BLUEFISH	2
	SCUP	3
	MENHADEN	3
	SILVER HAKE	4
	COD	4
	HADDOCK	5
	POLLOCK	4
	FOURBEARD ROCKLING	4
	CUNNER	3
	TAUTOG	3
	SUMMER FLOUNDER	2
	YELLOWTAIL FLOUNDER	4
	AMERICAN PLAICE	5
	ATLANTIC HALIBUT	5
EGGS DEMERSAL LARVAE PLANKTONIC	ATLANTIC HERRING	4
	AMERICAN SAND LANCE	2
	LONGHORN SCULPIN	2
	BLACKBACK FLOUNDER	3
	OCEAN POUT	4
	NORTHERN PUFFER	
	SHORTNOSE STURGEON	1
	ALEWIFE	1
	BLUEBACK HERRING	1
	SMELT	1
	ATLANTIC SALMON	1
EGGS BUOYANT LARVAE PLANKTONIC	WEAKFISH	3
	WITCHFLOUNDER	5
	STRIPED BASS	1
	CUSK	5
	RED HAKE	4
	WHITE HAKE	4
	BUTTERFISH	3
EGGS DEVELOP AND REDFISH HATCH WITHIN OVIDUCT. LARVAE PLANKTONIC		

1 = ANADROMOUS AND CATADROMOUS
2 = SPECIES WHICH SEASONALLY OCCUR IN THE ESTUARY BUT DO NOT REQUIRE IT FOR A SPAWNING OR NURSERY AREA.
3 = SPECIES WHICH UTILIZE THE ESTUARY FOR A SPAWNING OR NURSERY AREA.
4 = MARINE SPECIES WHICH MAY RANDOMLY OCCUR IN THE ESTUARY.
5 = MARINE SPECIES TAKEN IN OFFSHORE SAMPLING, NOT LIKELY TO BE FOUND IN AN ESTUARY.

usually greatest from the southern New England shelf to Georges Bank (Smith et. al., 1979). Larval abundance for both species is greatest during spring. Georges Bank is also a major spawning ground for Atlantic herring and high larval densities occur on the central and northeastern Bank in addition to Nantucket Shoals, coastal western Gulf of Maine, and along the southwestern Scotian shelf (Dube et. al., 1977; Colton et. al., 1979; Lough and Boltz, 1979) (see Visual No. 5). Atlantic herring spawn progressively later from north to south during fall (Lough and Boltz, 1979). Larvae of the northern sand lance dominate winter ichthyoplankton populations (Dube et. al, 1977).

Other larval fish common in ichthyoplankton collections on Georges Bank include pollock, American eel, windowpane, rockling, cusk, lumpfish and American conger eel (Marak and Colton, 1961; Marak et al., 1962a, b; Dube et. al., 1977). Surveys of coastal areas of southern New England collected species with more southern affinities: American sand lance, bay anchovy, and menhaden in Long Island Sound (Wheatland, 1956); and cunner, red hake, weakfish and yellowtail flounder in Block Island Sound (Merriman and Schlar, 1952).

C. Socio-Economic Environment

1. Population

The region considered in this EIS consists of 49 counties (Table III.C.1-1 and Figure III.C.1-1) exhibiting a wide range of population characteristics. This range is representative of the great diversity of social and economic activity in the study area. Population densities (Table III.C.1-1) vary from 62,067 persons per square mile in Manhattan, New York (highly urban) to 14 persons per square mile in Washington County, Maine (sparsely populated). Though all the states studied but Maine and New Hampshire experienced net out migration during 1970 through 1978, certain counties in all states experienced net immigration. (Table III.C.1-1).

2. Recreation

Coastal recreational activities popular in the North Atlantic include swimming, sunbathing, surfing, beach hiking, boating, fishing, hunting of waterfowl, bird watching and whale watching. Participation in all of these activities is high, but the peak season for each activity is short due to the climate. July and August comprise the peak season for swimming and beach use, whereas the spring and fall would be peak times for bird watching and whale watching during migration periods.

Much of the Atlantic coast from Maine through New Jersey is heavily used for recreation and open space. Major federal, state and local coastal recreation and open space areas in these states are shown on Visual No. 2.

Table III.C.1-1. Population by County

County Name (Locations on Figure III.C-1-1)	1980 County Population	Net Migration1 1970-1978 (Percent)	County Area (Sq. mi.)	Population Density (Persons/sq. mi.)
MAINE				
1. Washington	34,963	11.3	2,554	14
2. Hancock	41,781	13.5	1,536	27
3. Waldo	28,414	14.1	737	39
4. Knox	32,941	11.8	369	89
5. Kennebec	109,889	4.4	872	126
6. Lincoln	25,691	20.4	454	57
7. Sagadahoc	28,795	8.7	257	112
8. Androscoggin	99,657	0.2	474	210
9. Cumberland	215,789	3.2	879	245
10. York	139,666	9.9	1,001	140
NEW HAMPSHIRE				
11. Rockingham	190,345	21.7	691	275
12. Stafford	85,408	12.4	376	227
MASSACHUSETTS				
13. Essex	633,632	-4.0	494	1,283
14. Middlesex	1,367,034	-4.5	825	1,657
15. Norfolk	606,587	0.6	394	1,540
16. Suffolk	650,142	-8.2	56	11,610
17. Plymouth	405,437	12.5	654	620
18. Barnstable	147,925	46.8	393	376
19. Nantucket	5,087	39.7	46	111
20. Dukes	8,942	34.4	104	86
21. Bristol	474,641	2.9	554	857
RHODE ISLAND				
22. Providence	571,349	-4.0	416	1,373
23. Bristol	46,942	-3.8	25	1,878
24. Newport	81,383	-19.1	115	708
25. Kent	154,163	2.1	173	891
26. Washington	93,317	-1.9	321	291
CONNECTICUT				
27. New London	238,409	(z)22	667	357
28. Middlesex	129,017	4.4	372	347
29. New Haven	761,337	-1,8	604	1,260
30. Fairfield	807,143	-1.1	626	1,289
NEW YORK				
31. Suffolk	1,284,231	8.4	929	1,382
32. Nassau	1,321,582	-3.9	289	4,573
33. Queens	1,891,325	-4.4	108	17,512
34. Kings	2,230,936	-17.8	70	32,156
35. Richmond	352,121	9.5	58	6,071
36. New York	1,427,533	-11.3	23	62,067
37. Bronx	1,169,115	-20.6	41	28,515
38. Westchester	866,599	-3.8	443	1,956
39. Putnam	77,193	19.5	231	334
40. Dutchess	245,055	0.7	813	301
41. Orange	259,603	8.8	833	312
42. Rockland	259,530	6.7	176	1,475
NEW JERSEY				
43. Passaic	447,585	-8.0	192	2,331
44. Bergen	845,385	-5.0	234	3,613
45. Essex	850,451	-14.5	130	6,542
46. Hudson	556,972	-11.5	47	11,850
47. Union	504,094	-8.0	103	4,894
48. Middlesex	595,893	-3.5	312	1,910
49. Monmouth	503,173	4.5	476	1,057

Source: U.S. Bureau of the Census, 1977 and 1980.

(1) Births and deaths are based on reported vital statistics from April 1, 1970 to December 31, 1977, with extrapolation to June 30, 1978. Net migration is the difference between net (population) change and the natural (i.e., births and deaths) change.

(2) Less than 50 persons or less than 0.05 percent.

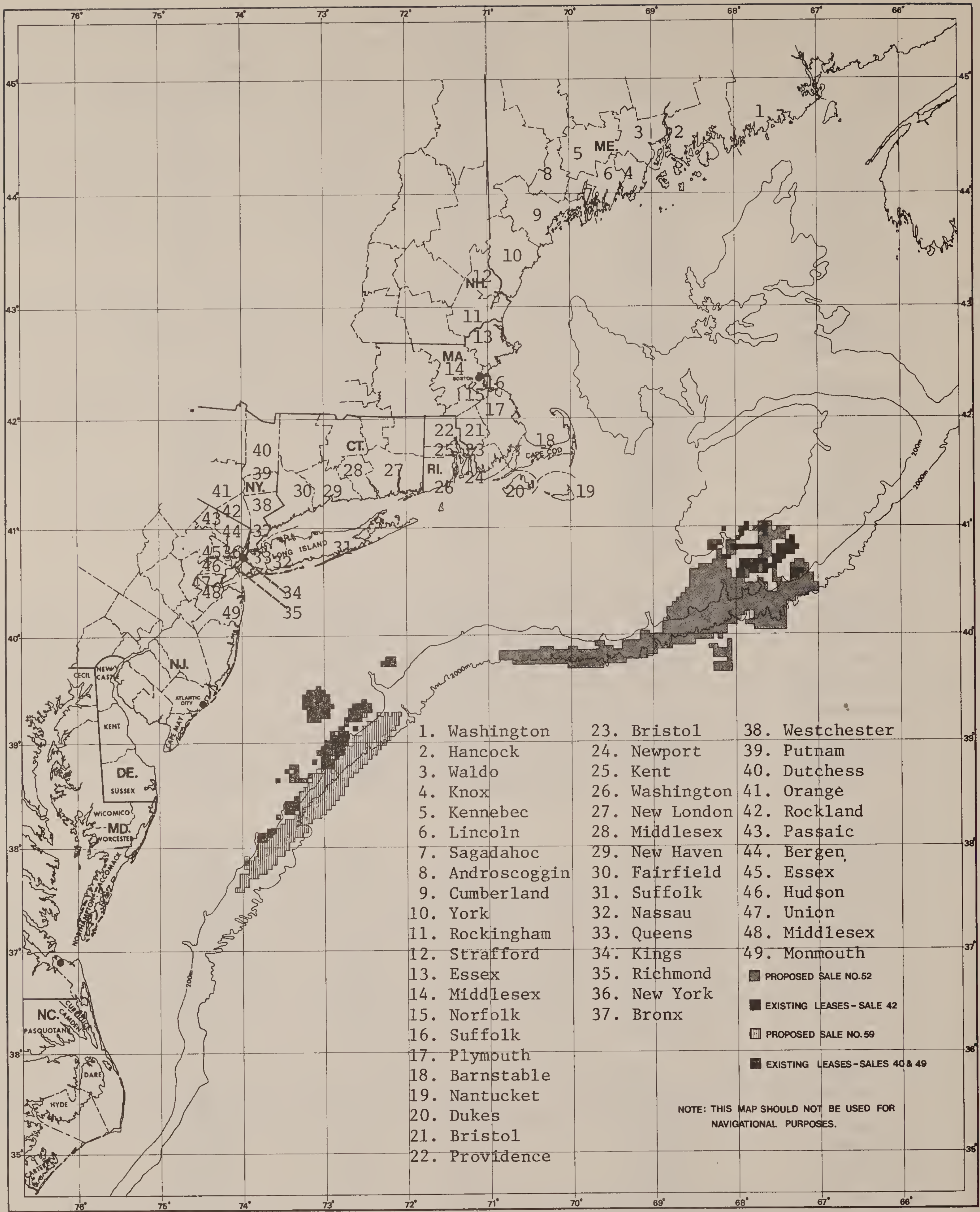

Figure III.C.1-1. Counties in Region Considered in this EIS.

Of the four major coastal recreation areas in the region administered by the National Park Service, Acadia National Park in Maine received over 2.7 million recreation visits in 1980, Cape Cod National Seashore in Massachusetts had over 4.7 million, Fire Island National Seashore in New York over 600,000, and Gateway National Recreation Area with sites in New York and New Jersey over 9 million.

The 1971 National Shoreline Study indicated that 336 miles of the New England coastline were devoted to public recreation use and another 2292 miles were in private recreation use. Together recreation uses occupied about 60% of the region's shoreline. When the region is viewed in the context of two subregions, the coast of Maine and the remainder of New England, recreation use is even more pronounced. Along the New Hampshire, Massachusetts, Rhode Island and Connecticut coasts, almost 90% of the shore is used for recreational purposes.

The coastal recreation areas closest to the proposed lease area are on Cape Cod, Martha's Vineyard, and Nantucket Island, all part of Massachusetts. In 1979, Cape Cod received over 7.9 million visits for recreation related purposes, Nantucket received about 623,000 and Martha's Vineyard about 641,000. These visits directly contributed to the spending of $247.4 million on Cape Cod, $19.4 million on Martha's Vineyard and $21.0 million on Nantucket. About half of the visits and expenditures in these areas occurred during the months of July and August. (Cournoyer and Kindahl, 1980).

In general, figures on demand for coastal recreation show that there is even greater demand than actual use. Supply is often limited by access problems, such as availability of parking or public transportation or lack of rights-of-way to reach coastal areas. States are addressing the problem of increasing access where feasible. Information on demand and supply is covered in each state's Statewide Comprehensive Outdoor Recreation Plan (SCORP).

For further discussion of participation in coastal recreation activities in the states in the North Atlantic leasing region, see the Sale No. 42 FEIS, p. 466-486, and the FSEIS, p. 120-130.

3. Oil and Gas Infrastructure

The North Atlantic Coastal Region contains five refineries as described in the Table below.

Chevron Oil Company	Perth Amboy, N.J.	168,000 b/d
Exxon Corporation	Linden, N.J.	270,000 b/d
Atlantic Terminal Corporation	Newington, N.H.	12,800 b/d
Amerada Hess Corporation	Newington, N.H.	68,000 b/d (closed)
Mobil Oil Company	East Providence, R.I.	7,500 b/d (closed)

The three in operation have a total capacity of 451,000 barrels per day. The majority of this capacity is located in the Raritan Bay area of northern New Jersey, and refines crude oil delivered by tanker or barge from foreign sources. The New Hampshire refinery receives domestic or foreign crude by tanker.

Currently there are no natural gas processing plants in the North Atlantic Coastal Region. Natural gas is delivered from the Gulf of Mexico region by large diameter, high pressure interstate pipelines (See Visual 1). The natural gas transmission system traverses the coastal region of each state in the study areas as far north as Portland, Maine.

In addition, there is an extensive network of small diameter, low pressure, interstate gas distribution pipelines. Peakshaving needs are provided for by various LNG (liquified natural gas) and SNG (synthetic natural gas) facilities in the area.

4. Ports and Shipping

Major New England ports for handling cargoes include: Portland, Maine; Portsmouth, New Hampshire; Boston, and Fall River in Massachusetts; Providence, Rhode Island; and New London, New Haven and Bridgeport in Connecticut. Of these, Boston generally has the greatest percentage of inbound total tonnage and Portland the next greatest. Boston usually also leads in outbound total tonnage, followed by New Haven (NERBC. 1980). Crude oil and refined petroleum products comprise over 90% of the tonnage handled in these New England ports. Of nearly 26 million short tons of freight handled in Boston Harbor, about 23 million consisted of petroleum products. Almost all of the crude oil tankered to New England goes to Portland, Maine, (over 12 million tons) from where it is transported by pipeline to Canada (U.S. Army Corps of Engineers, 1978).

The Davisville/Quonset, Rhode Island port complex is located along the west passage of Narragansett Bay approximately 20 miles south of Providence. This complex has been serving as the supply base for OCS exploration activities in the Mid-Atlantic and will serve the same purpose when exploration begins in the North Atlantic.

Mid-Atlantic ports that could be the destination of crude oil produced on the North Atlantic OCS include the Port of New York and New Jersey, and Philadelphia. New Jersey and Philadelphia area refineries receive shipments of imported and domestic crude through these ports.

Traffic Separation Schemes (TSSs) and Precautionary Areas have been established for the approaches to New York, Boston, and Portland Harbors and Narragansett and Buzzards Bays. These TSSs and Precautionary Areas are shown on Visual No. 1.

The TSSs consist of one-way traffic lanes recommended for use by all vessels traveling between the points involved. Separation zones are intended to separate inbound and outbound traffic and to be free of ship traffic. Separation zones are meant to be used only for crossing purposes. Mariners are advised to exercise extreme caution when crossing traffic lanes and separation zones, and when navigating within Precautionary Areas.

The Intergovernmental Maritime Consultative Organization (IMCO) is the maritime arm of the United Nations and is the international authority on vessel routing measures. IMCO has designated an area in the region of Nantucket Shoals as an area to be avoided effective March 1, 1981. This area, shown on Visual No. 1, is the first to receive such a designation. All vessels carrying cargoes of oil or hazardous materials, and all other vessels of more than 1000 gross tons are put on notice of the great danger of stranding within this area.

The Port and Tanker Safety Act of 1978 which amended the Ports and Waterways Safety Act of 1972 gave the Coast Guard the authority to establish Port Access Routes for vessels operating in the approaches to U.S. ports and in the traditional routes between ports.

The Coast Guard is required to study the need for such routing measures before actually proposing them. If a shipping safety fairway or a traffic separation scheme were adopted as a result of these studies, there could be restrictions on the manner in which specific areas leased after April 16, 1979 may be explored and developed for extraction of natural resources.

Of the areas affected by proposed Sale No. 52, some were studied by the First Coast Guard District and some by the Third Coast Guard District. The four areas studied by the First Coast Guard District are: 1) Northeast coast of Maine; 2) Searsport, Bucksport and Portland, Maine, and Portsmouth, New Hampshire; 3) Boston, Massachusetts; and 4) Fall River and New Bedford, Massachusetts, and Providence, Rhode Island. Study results for Areas 1, 2 and 4 are not yet available.

Study Area 3, the approach to Boston Harbor includes the Georges Bank area. The preliminary conclusions for Area 3 are that the existing Traffic Separation Scheme (shown on Visual No. 1) is adequate for the traditional trade routes and amount of traffic to and from the port of Boston, and that a "precautionary area" may be needed in the area of intersection between the Boston Harbor Traffic Lanes and Nantucket to Ambrose Traffic Lanes (U.S. Coast Guard, 1981).

Areas 5, 5a and 6, which include New York Harbor, Long Island Sound and Delaware Bay were studied by the Third Coast Guard District. They are also not recommending that port access routes be established at this time. If a port access route is necessary in the future, the Third Coast Guard District will recommend that it be established using existing Traffic Separation Schemes (shown on Visual No. 1) extended to the 1800 meter contour, and without having biennially alternating lanes. (U.S. Coast Guard, Third Coast Guard District, Personal Communication, 1981).

All study conclusions are contingent upon final review and approval by Coast Guard Headquarters staff, but it is unlikely that Headquarters actions will go beyond the proposals of the District study teams. Areas will be restudied if major oil/gas activity develops in the region. The Coast Guard will continue to insure that clear port access routes are maintained with a minimal impact on mineral extration (U.S. Coast Guard, 1981).

5. Military Activity

Portions of the water and air space of the North Atlantic Outer Continental Shelf and adjacent shoreline are used for various military operations essential to training, readiness, and support of national defense and security interests. These operations include training and testing activities such as submarine operations, gunnery practice, sea trials, radar tracking, warship maneuvers, and genera operations. These activities normally take place in areas specifically designated for such purposes that are under the control of the Department of Defense. The Boston and Narragansett Bay Operating Areas and part of the Atlantic City Operating Area are shown on Visual No. 2.

These operating areas were established for training of surface, submarine and air units in addition to providing designated zones for testing ordnances, aircraft and ships under cognizance of the U.S. Armed Forces and other Federal agencies. While the public cannot legally be restricted from using these operating areas, the areas are normally established where adjacent airspace has been formally designated as a warning area (where hazards to aircraft may exist).

The Boston Operating Area's controlling authority is Commander, Submarine Squadron TWO, Naval Submarine Base, Groton, Connecticut. The Narragansett Bay and Atlantic City Operating Areas' controlling authority is Commanding Officer, Fleet Area Control and Surveillance Facility, Virginia Capes Naval Air Station, Oceana, Virginia. These controlling authorities have the responsibility for directing and coordinating oceanic and air activities with OCS oil and gas exploitation activities.

Mariners are notified of military operations which may interfere with navigation in the local notices to mariners which are issued on a weekly basis by the local Coast Guard District Commander. Marine information of immediate concern is broadcast over various radio frequencies by the Coast Guard in the marine broadcast notice to mariners.

6. Historical and Archaeological Resources

The coastal areas in the North Atlantic Region have played a prominent part in American history. The ports of Boston and New York were important settlements during colonial times as were the smaller port areas of Providence and Newport, Rhode Island and Portland, Maine. In addition, these ports served as major entry points for waves of immigrant groups which have enriched America's heritage. Consequently, the region contains many buildings, structures, and sites that are important to the preservation of American history, architecture, and culture, the majority of which are located inland from the surf/tidal zone. There are almost 1200 sites on the National Register of Historic Places dating from the 17th, 18th and 19th centuries, which exist in the five New England coastal states and the three New York/ New Jersey counties in close proximity to the study area. The overwhelming

majority of these sites, however, are inland from the actual coastline. Only those sites which are coastally oriented could be affected by OCS-associated development. Most of the coastally oriented sites listed on the Register or eligible for nomination to the Register are ports, coastal fortifications, historic districts, or lighthouses. These sites are often protected by various means such as bulwarks or other barriers.

Evidence of prehistoric occupation of the coastal area of the Atlantic region from the earliest Paleo-Indian period (primarily hunter/gatherers) through the Archaic (nomadic Indian tribes adapted to both forest and coastal living) and into the Woodland periods (which lasted until contact with the first European settlers) is found throughout the area from the tidal zone landward. Rudimentary sites from early cultures and larger habitation sites and burial complexes are also present in this area.

The probability of sites or artifacts existing in the Proposed Sale No. 52 area is low, given that a large percentage of the area was probably covered by water since 18,000 years B.P. (Before Present). About 206 tracts lying in present water depths less than approximately 200m (the shelf-slope break) are thought to have ever been above sea level. There is a possibility that small sites occurred at a low frequency when these tracts were above sea level. Expected types of sites would include fishing camps, habitations, and shell middens. Due to Pleistocene sea-level changes and reworking of the sediments by the localized and regional current regimes, there would be partial to negligible preservation of any possible sites expected in these tracts at the present time (Institute for Conservation Archaeology, 1979). There are numerous shipwrecks in the Georges Bank Region, several of which are located in the tracts selected for environmental study (See Visual 1). None of these shipwrecks, however, are considered of historic importance.

Section 4

Environmental Consequences

IV. Environmental Consequences

A. Impact Producing Agents

1. Offshore Facilities and Debris on the Ocean Bottom

Exploratory Operations

Offshore exploratory drilling operations in the proposed Sale No. 52 area are expected to take place from three basic types of drilling rigs: Jack-ups, semi-submersibles, and drillships. Jack-up rigs are used out to water depths of approximately 350 feet and occupy about 1 acre of the sea surface. Beyond this water depth, semi-submersibles or drillships are utilized. These rigs may be positioned over the drill hole by either of two methods: a conventional wire rope/chain mooring system or dynamic positioning. Semi-submersibles occupy approximately one acre of the sea surface and have typical operating drafts of about 60 to 90 feet. A semi-submersible anchored by chains or ropes would take up considerably more surface and subsurface area than a rig equipped with dynamic positioning systems. Dynamic positioning, a system employing thrusters for maintaining precise position over the drill hole, is utilized mainly in deep waters where anchoring lines are not feasible.

Deep water drilling may also take place from a dynamically positioned drillship. Lengths of drillships vary from about 445 feet to the massive Glomar Explorer with a length of 618 feet. Drillships widths may be as much as 70 to 90 feet. Exploratory drilling rigs are generally equipped with living facilities for approximately 85 to 130 crewmen.

The placement of these structures may involve some disturbance of the sea floor with possible adverse effects on biological and/or cultural resources. Disturbance of the sea bed is minimized when dynamically positioned rigs are utilized. In addition, the actual area which these structures will take up and the resulting spatial exclusion could be a hindrance to fishing and navigation.

For the mean resource estimate USGS predicts there will be about 17 exploratory wells drilled in the proposed sale area. Approximately 3 to 6 months time is involved in the drilling of an exploratory well. The time factor is dependent mainly on the type and hardness of the sediment being drilled through and the depth beneath the seabed to which the well is being drilled.

Additional impacts on fishing and navigation during exploratory operations could be caused by the transportation of supplies from onshore support bases to the drilling rigs (see Sections IV.C.8 and IV.C.9). Collisions of fishing or supply boats with rigs may also occur. In the Mid-Atlantic area to date, collisions with exploratory rigs have been very infrequent and minor in nature, consisting of work boats bumping against the rigs during normal loading and unloading operations with no serious damage or injury.

Debris generated by platform installation and operation could pose a problem for the fishing industry. Debris tossed or lost overboard a drilling vessel could consist of such items as pipes, wire, tools and old tires. Damage to fishing nets or catch is possible. The nets could be damaged if debris should become entangled during fishing operations. The catch can be damaged should the debris become entangled during deployment or retrieval of fishing gear.

OCS Order No. 1 requires the identification of all subsea objects and equipment used on rigs or vessels which might be lost overboard. All items must be color-coded, stamped, or labeled with the owner's identification markings. Thus, responsibility for damage can easily be determined.

Development and Production

Production platforms expected in the sale area include bottom-founded steel-jacket platforms, guyed towers, and tension leg platforms. Bottom-founded structures are feasible out to depths of about 1000 feet. Beyond this depth, the massive amounts of steel required for support becomes uneconomical. Deeper waters require lighter, more compliant platforms.

The development of the guyed tower design has been pioneered by Exxon Production Research. Exxon's design calls for a structure having four legs spaced 100 feet apart with diameters ranging from 5 to 8 feet. The sides of the deck levels are each 150 feet providing 45,000 square feet of space. The structure is supported by twenty 3 1/2 inch guy lines. Since the guy line cables will be run down from the structure at about a 60 degree angle, the tower will take up considerably more sea area than the deck space indicates.

Exxon's guyed tower is being designed to withstand the severe wind and wave conditions normally experienced in the North Sea. Computer testing indicates that deck offset (amount of deck movement) would be minimal even if the tower was subjected to 8-sec. waves of 50-ft or more in height (Finn, 1978). Testing of a prototype guyed tower in the Gulf of Mexico for 10-months indicated that the in-place structure had adequate strength to survive a storm bearing waves as high as 100 feet (Pierce, 1976). The tower should also be able to survive wind speeds as great as 100 miles/hr. Maximum wind and weather conditions expected within the proposed sale area are discussed in Section IV.B.2. These maximum conditions are of lesser magnitudes than those for which the guyed tower is being designed. Therefore, the possibility of structural collapse during periods of intense storm activity seems remote.

Conoco has been the major force behind the development of the tension leg platform (TLP). Conoco's basic tension leg platform design calls for a main deck roughly 250 feet by 240 feet with an operating draft of 98 feet. The structure will be anchored by tensioned cables attached to templates firmly anchored to the sea bed by groups of drilled piles which may reach up to 375 feet below the seabed.

Conoco's TLP design calls for a structure capable of withsranding waves of 30 m (94 ft) in height at a period of 17 seconds. Wind speeds up to 44 m/sec (98.5 mi/hr) will also have little effect in relation to deck offset. These are roughly the conditions associated with the 100-year northern North Sea storm. Maximum wind and wave conditions expected within the proposed sale area are discussed in Section IV.B.2. These maximum conditions are of significantly lesser magnitudes than those conditions associated with the 100 year northern North Sea storm.

Both the guyed tower and tension leg platform will require offshore crews of about 100 persons. The installation of piles, guylines, and templates will obviously involve some degree of seabed disturbance and the actual placement of the structures could involve some loss of fishing grounds.

Production of oil or gas within the proposed sale area may also be accomplished through the installation of subsea completion systems. These systems can be utilized with or without production platforms, but some production facility is needed, possibly a production/storage vessel. This vessel could be located in shallow water where it probably would be hooked up to a moored buoy/production riser system.

The construction and development of subsea completion systems could involve some disturbance of the seabed and associated bottom surface impacts, as well as interference with fishing activities such as trawling. There could be from zero to 97 subsea production complexes resulting from this proposal, with a mean of 31 expected.

More information on the technological aspects of the facilities used for deep water exploration, development, and production is given in Appendix G. Additional impacts as a result of oil and gas production activities could result from increases in helicopter and supply boat operations. These activities, in addition to possible tanker operations, could be a hindrance to recreational and commercial vessel traffic. Information regarding the types and number of support vessels required per drilling rig may be found in Section IV.A.2. Possible burial and placement of pipeline could also have adverse impacts in the sale area and in coastal waters near pipeline landfalls. Possible impacts of pipeline placement include disruption of bottom sediments, resuspension of toxic materials, elimination of suitable sites for development of biotic communities, interference with trawl fishing, and damage to cultural artifacts. Placement of approximately 200 miles of pipeline would involve about 6 to 8 months of actual laying operations. These operations could hinder vessel traffic in the proposed sale area.

As mentioned previously under Exploratory Operations, debris on the sea bed resulting from oil and gas activities could adversely impact fishing equipment and catch.

An additional obstruction to vessel traffic and fishing activity could be the offshore gas compressing stations which may be required for proper operation of a gas pipeline system. These stations would most likely be found in water depths which support conventional bottom-founded platforms.

2. Onshore Facilities

A variety of facilities will be required in order to support the offshore oil and gas operations resulting from proposed Sale No. 52. The discussion which follows focuses upon the characteristics of the facilities which are projected to be required as a result of this proposed sale. More detailed information regarding each of these facilities may be found in the New England River Basins Commission Factbook.

For some facilities, the economic and socikl impacts of construction may exceed the impacts of operation. The environmental effects would depend on the site characteristics, but could involve vegetation and soil removal with resulting habitat destruction, runoff, dust and other impacts associated with similar industrial developments.

For purposes of environmental analysis, assumptions are made concerning the location of these facilities; these assumptions are explained in Appendix C. Conflicts between the assumed location of these onshore facilities and land use plans and policies are discussed in Section IV.C.11.

Operations Support Bases: Support bases are essentially port facilities which require dockside space, warehousing, open air storage, and a small amount of office space. A helicopter pad may also be located in conjunction with a support base or companies may seek helicopter sites closer to the offshore operating areas. Any given port area may service more than one operator, either with separate facilities for each operator, or common facilities provided by a service company. Where available, leasing or acquisition of areas with existing port facilities is most attractive for support bases, with the possibility of renovation or the construction of new facilities.

Support bases serve primarily as storage and staging areas for supply vessels. Because of the size, draft, and servicing requirements of these vessels, they can be easily accommodated in ports serving fishing vessels, causing potential conflicts in competition for space. Ports utilized solely by pleasure craft are not likely to have appropriate services (repairs, supplies, etc.) or drafts (15 to 20 feet). Additionally, ports serving large cargo ships and tankers engaged in international trade may not be prepared to service smaller supply vessels.

The support bases assumed to be used for operations from proposed Sale No. 52 would not create any such conflicts, however. Davisville, RI is currently being used for operations support for both Mid- and North

Atlantic exploration activity. It is assumed to continue in such use for operations support of leases resulting from proposed Sale No. 52. In addition, a support base is assumed to be sited on Staten Island, New York, in the Stapleton area. For the proposed Sale No. 52 mean case, 80% of the support is projected to come from Davisville and 20% from Stapleton.

Space requirements depend on the number of offshore facilities being served, since the space required is determined primarily by the amount of drill pipes, muds, and other supplies being stored, and by berthing space for the vessels required to supply the offshore rigs or platforms. If only two or three exploratory wells are being drilled at any one time, less than 25 acres may be required. For a base supporting more operations, anywhere from 50 to 100 acres per base could be required.

The number of vessels operating out of the base varies with the number of three production facilities. During drilling activity the need for supply boats is higher; two or three supply boats may be needed for each exploratory or development drilling rig. Additional supply boats and tugboats are also required during platform, subsea completion, and pipeline installation. Each supply boat would employ about 11 people working in shifts. Platform crews are transported either by helicopter or by crew boats. Crew boats employ about six persons and are used where the platforms are close to shore or where severe weather conditions prohibit the use of helicopters. A helicopter needs about three people and can service up to five producing platforms. Helicopter support is assumed to be from the Barnstable Municipal Airport in Hyannis, Massachusetts.

Pipecoating Yard: Prior to the laying of a pipeline on the OCS, it must be coated with a concrete and asphalt sealant for underwater use. It has been assumed that pipecoating operations for this proposed sale would take place at an existing facility in Bucks County, Pennsylvania.

Pipelines: During pipeline installation, support facilities for pipelaying vessels are required. These facilities would be similar to any bases which support drilling and production operations and may be sited in conjunction with the support bases.

Onshore pipeline rights-of-way (ROW) are normally 50 to 100 feet wide. Of this, 30 to 40 feet of soil and vegetation may be removed, and a total of 50 to 60 feet may be disturbed by pipelaying equipment. If pipelines are placed in well-drained areas without excessive slope, the effects of burial would be temporary. If laid in wetlands or other less suitable areas, careful planning and design would be required to mitigate potential environmental effects and prevent exposure of the line.

The two gas pipelines that could be needed to transport production from proposed Sale No. 52 are assumed to be 36 inches in diameter each and to landfall along the southern shore of Little Compton, Rhode Island. Onshore they are assumed to share a 65 to 80 foot right-of-way.

Gas Plants: Gas processing plants are custom designed for an individual gas stream, so that the extent of treatment or processing required depends on the composition of the gas, the size of the field, and the transportation strategy chosen, among other variables.

Gas produced offshore is generally separated into a gas stream and a liquid stream, from which free water is removed, for measurement at the platform. Oil or natural gas liquids may be reinjected into the gas stream before transportation to shore. Before it enters a commercial natural gas transmission line, further treatment of the gas may be required, depending on its composition and sulfur content.

In a gas separation/dehydration facility, separation refers to the removal of free liquids from the stream. These liquids may be either hydrocarbon liquids or free water. Dehydration occurs after separation to remove any water vapor remaining in the gas stream. Not all gas streams require further processing after separation and dehydration.

If the gas contains too much sulfur, particularly hydrogen sulfide, it must be treated to reduce the level of sulfur before the gas can be sold commercially. This usually occurs onshore.

A gas processing plant would be built to recover valuable liquefiable hydrocarbons not removed by normal separation methods. These natural gas liquids would then be fractionated into ethane, propane, butane and heavier hydrocarbons, although fractionation does not have to occur at the same location as processing.

Such facilities would be constructed along the pipeline route between the landfall and an existing natural gas transmission line. Treatment or processing of the gas close to shore is not necessary as long as the sulfur content is not excessive, although a coastal site is often preferred. Economic considerations can make processing near a market for the gas fractions more desirable.

The gas from the two natural gas pipelines projected to be needed as a result of proposed Sale No. 52 is assumed to be processed in a plant located in Bristol County, Massachusetts, in the Fall River area near Freetown. The plant would require a site of about 96 acres and have a capacity of 1.42 BCF/D.

Marine Terminals: A marine terminal typically includes dock space for tankers and barges, transfer equipment, and storage tanks. These terminals are used for waterborne shipments of crude oil. Since any crude oil expected to be produced as a result of proposed Sale No. 52 is assumed to be processed at existing refineries, no new marine terminals for offloading the crude would be required as a result of this proposal.

Ancillary Facilities: Several small service or support companies may be established in a region to support OCS development. Some of these, such as ship supply, tool, and drilling mud companies are already serving existing operations from locations at Davisville, RI. Other specialized companies may be required as operations increase. None of these require more than 5 acres and most require less. Only mud suppliers and cementing companies require water dockside and ocean access; most are small employers, and most would be expected to locate or expand in existing industrial and commercial sites. Other less specialized services may be provided by companies already in an area, perhaps through expansion. Examples of these are trucking firms, caterers, and welding shops.

3. Water Pollutants

Sources of water pollution related to OCS exploration and development include discharges of oil, both large acute spills and chronic discharges; formation waters; drilling muds and cuttings; sanitary wastes; deck drainage; and pipeline installation.

The discharge of effluents is subject to EPA National Pollutant Discharge Elimination System (NPDES) permit regulations which require the application of "Best Practicable Control Technology Currently Available" (BPT), as specified under Section 301(b)(1)(A) of the Clean Water Act, and effluent limitations found at 40 CFR (13 April, 1979) and 40 CFR 125 (3 October, 1980) or, if ocean dumped, at 40 CFR 227-228 (11 January, 1977) (Environmental Protection Agency, Correspondence, February 5, 1981). Table IV.A.3-1 contains a list of typical drilling rig discharges. Specific NPDES permit requirements for North Atlantic OCS Sale No. 42 operations are summarized in Appendix I, under EPA Region I NPDES Permit Responsibilities.

In addition to oil spill accidents during production and transportation, petroleum hydrocarbons can be released within routine discharges from exploration vessels, platforms, and OCS support vessel activity. Petroleum released into the water column is subject to many different physical, chemical, and biological processes that modify the original composition. These are collectively termed "weathering" processes, and include spreading, evaporation, dissolution, emulsification, chemical oxidation, and biodegradation. The rates of each process cannot be predicted because these depend

TABLE IV.A.3-1
TYPICAL RIG DISCHARGES

Discharger Name and Parameters	Average Flow Rate Minimum gpd	m3/d	Maximum gpd	m3/d
Drilling Mud System (Active and Reserve Drains)				
Average Flow Rate	1,800	6.8	11,300	42.8
Drill Cuttings and Washwater				
Average Flow Rate of Cuttings				
Average Flow Rate of Washwater	4,000	15.1	12,000	45.4
Contaminated Deck Drainage (Work Area Drainage)				
Average Flow Rate	800	3.2	14,000	53.0
Sanitary Waste Discharge				
Average Flow Rate (Salt Water Used)	1,500	5.7	5,000	18.9
Kitchen & Shower Discharge (Grey Water)				
Average Flow Rate	1,500	5.7	8,000	30.3
Water Distallation Discharge				
Average Flow Rate (Salt Water Brine)	5,000	18.9	36,000	136.3
Clean Deck Drainage (Rainwater and Washwater)				
Average Flow Rate	2,800	10.6	13,200	50.0
BOP (Blow Out Prevention System) Fluid				
Average Flow Rate	10	0.1	500	1.9
Boiler Blowdowns				
Average Flow Rate	-	-	200	0.1
Five Water Systems				
Average Flow Rate		System Test Only		
Cooling Water (Power Generation System) (Exxon Only)				
Average Flow Rate	400,000	1515	5.2/MGD	19690
Delta Temperature (Discharge °F - Inlet °F)	-	-	5°F	-

TABLE IV.A.3-1 - (continued)
TYPICAL RIG DISCHARGES

Discharger Name and Parameters	Average Flow Rate Minimum gpd	m3/d	Maximum gpd	m3/d
Ballast Water Average Flow Rate (with no additives)	3,000	11.4	26,000	98.4
Cementing Unit & Washdown Drains Average Flow Rate	20	0.1	500	1.9

Source: U.S. Environmental Protection Agency, 1981

not only on the physical characteristics of the spilled oil but also on the environmental conditions existing at the time, such as air and water temperature, nutrient levels, light intensity, winds, currents, particulate matter, waves and physiography. Weathering processes are discussed at length in the FEIS for OCS Sale No. 49 and for Sale No. 42. Basically, from 20 to 50 or 60 percent of spilled crude oil evaporates within a few days. The remainder may form emulsions in the water column or may be dispersed by waves and surface turbulence to undergo further weathering and sedimentation, or transportation away from the spill site.

Hydrocarbons in crude oil can be placed into four major clases: paraffinic (alkanes), naphthenic (cycloalkanes), aromatic, and naphtheno-aromatic. Crude oils from different sources can differ appreciably in percentage composition of the various hydrocarbon fractions. It is the highly soluble and volatile low molecular weight fractions (e.g. aromatics) that are responsible for the more immediate acute toxic effects to biota, while the high molecular weight more persistent fractions are less soluble and volatile but may cause long-term chronic effects. (FEIS OCS Sale No. 49 p. 373-392).

Although crude oil consists primarily of hydrocarbon compounds, it also contains a variety of other compounds that contain sulfur, oxygen, nitrogen, and some trace metals. Trace metals in crude oil are present in very small concentrations with nickel and vanadium usually the largest proportion and cobalt, mercury, iron and zinc present in smaller amounts (FES OCS Sale No. 49, p. 392).

During petroleum production, formation water is recovered along with the oil. Formation water is derived from interstitial water that was laid down with the sediments, and during compaction subsequently displaced from the resulting formation. This water must be removed during resource production and, if not reinjected or injected into disposal wells, discharged to the marine environment after treatment (FEIS OCS Sale No. 53).

Formation waters can vary from 20 percent to 150 percent of oil production volume. Very small amounts are produced during the initial drilling phase, while maximum production occurs at the end of a given reservoir's life. Throughout the production life of a field, it is generally estimated that one barrel of formation water is produced per barrel of crude oil, assuming moderate water drive reservoirs (FEIS OCS Sale No. 49). For the mean resource estimate of 1.73 billion barrels of oil expected to be recovered over the life of the field under proposed Sale No. 52, an equivalent total amount of formation waters is assumed to be produced as well.

Formation waters contain dissolved inorganic salts in concentrations that vary widely, depending on the formation, but are usually several times greater than that of seawater. The properties of most concern however, which may adversely affect the marine environment are entrained oil or petroleum hydrocarbons, trace metals and low dissolved oxygen concentrations (FEIS OCS Sale No. 53).

Petroleum hydrocarbons are present in formation waters at concentrations which vary widely with geographic region and production stage of the formation. However, the EPA requires that before discharge formation waters must be treated such that the concentration of oil does not exceed 72 mg/l for any one day nor exceed an average 30-day concentration of 48 mg/l (40 CFR 435). Treatment usually consists of processing the water through an oil separation system.

During exploration and production, drilling muds and drill cuttings will be discharged into the marine environment. Drilling muds are complex chemical mixtures which are circulated through the well bore during drilling. Drill cuttings are those rock particles displaced during drilling. Drilling muds cool and lubricate the drill bit and drill pipe; transport drill cuttings to the surface and maintain those cuttings in suspension should circulation be interrupted; provide hydrostatic pressures to conteract formation pressures and thereby prevent blowouts; and support part of the drill bit and string weight.

The quantities and properties of both muds and cuttings discharged depend on the well depth, hole size, geologic formations encountered, mud dispersability, and solids control capacity (API, 1979).

During drilling operations, drilling mud is circulated down the well hole through the drill pipe, picking up drill cuttings, and returned to the surface. There, the cuttings and mud are separated, the cuttings discharged to the ocean, and the mud recirculated (FEIS OCS Sale No. 53). Drill cuttings are discharged continuously during drilling operations. The bulk of the discharged cuttings occurs for the 0-5000 foot depth (usually the first third of the program). With increasing well depth there is a decrease in the volume of cuttings per foot, due to the decreasing size of the drill bit, so that during the last two-thirds of drilling there are very small amounts of drill cuttings discharged (Petrazzulo, 1981).

Drilling muds are discharged to the water column intermittently in order to maintain desired mud properties, which change as drilling progresses. At the completion of a well a final bulk dump is also made. The largest daily discharges are likely to occur at the beginning and end of the drilling program.

Typically, over the life of a well, 10 - 30,000 barrels of drilling mud and 3-6,000 barrels of solids control materials are discharged into the water column (Ayers, 1981). The estimated volume of drilling discharges for proposed Sale No. 52 is given in Table IV.C.2-1, of Section IV.C.2 Impacts on Water Quality. Specifications for the discharge of drilling materials (eg: depth, rate) are designated on a case-by-case basis by the EPA in accordance with the NPDES permit program (see Appendix I) and by the USGS under OCS Order No. 7 (see Appendix E).

Basically, muds used on the OCS are a water-based clay (usually bentonite) suspension which contains barite for density control, and lower concentrations of chrome lignosulfonate, sodium hydroxide, lignite, and other chemical additives to control viscosity, fluid loss, corrosion, and other mud properties (EPA, 1981). Early in drilling, when structural or conductor casings are being run and cemented, the drilling fluid is usually seawater or a seawater-bentonite fluid. At the end of the drilling program the fluid is generally a high-density ferrochome lignosulfonate freshwater mud (Petrazzulo, 1981).

Table IV.A.3-2 contains a list of typical mud components. The number of additives used is extensive: there are 43 generic varieties of additives and at least 231 proprietary formulations. At any given well, depth, and time, a dozen or more additives may be used to control downhole conditions (API, 1978). Only those muds designated by the EPA to be environmentally acceptable as determined by bioassay test results can be used on the OCS.

Drilling-related additives that cannot be discharged on Sale No. 42 blocks include oil-based drilling fluids, halogenated phenol compounds, asbestos, sodium chromate, sodium dichromate, and trisodium nitrilo triacetic acid. EPA Region I has prohibited their discharge because they are highly toxic and suitable substitutes are available (EPA, 1981).

In the Georges Bank region, muds to be used on Sale No. 42 blocks have received EPA approval for present operations in the Mid-Atlantic. This is based on their low toxicity as demonstrated by bioassay analyses that were part of the operators' permit conditions. It is assumed that, unless further bioassay testing of these muds on sensitive species indigenous to Georges Bank leads EPA Region I to determine otherwise, these same muds will be discharged during operations on proposed Sale No. 52 blocks as well. The composition of three muds used in the Mid-Atlantic is given in Table IV.A.3-3 (U.S. EPA, 1981).

The major contaminants of concern in drilling discharges are solid particles, heavy metals (such as barium, chromium, lead, zinc, cadmium, and copper), and bacteriocides. Although bioassay toxicity data have indicated that most drilling fluid components are relatively non-toxic, some constituents, particularly heavy metals and bacteriocides, can be toxic and persistent. Consequently, the fate and effects of drilling discharges have been the subject of extensive study and controversy in recent years. Results of several of these studies are discussed in Section IV.C.2. Impacts on Water Quality and, pertaining to biota, in Section IV.C.3 and IV.C.4 - Impacts on Plankton and Benthos, Section IV.C.8 and IV.C.9 - Impacts on Fish Resources and Commercial Fishing, and also in the FEIS for OCS Sale No. 49 (Sections III.B., III.E., III.H. Appendix 12).

Deck drainage includes all effluents resulting from platform washings, deck washings, and run-off from curbs, gutters, and drains including drip pans and work areas. Constituents of concern in effluents are oil and grease.

Table IV.A.3-2

TYPICAL MUD ADDITIVES

TRADE NAME	CONSTITUENTS	USAGE
ALUMINUM STEARATE	Organometallic compound	S
AQUAGEL	Sodium montmorillonite	N
BARITE	Barium sulfate	N
CARBONOX	Lignite humic acid powder	N
CAUSTIC SODA	Sodium hydroxide	N
CELLEX	Sodium carboxymethylcellulose	S
DRISPAC	Polyanionic cellulosic polymer powder	N
IMPERMEX	Starch	S
LIME	Calcium hydroxide	N
MICATEX	Mica flakes	S
Q-BROXIN	Ferrochrome lignosulfonate	N
SAPP	Sodium acid pyrophosphate	S
SODA ASH	Sodium carbonate	N
SODIUM BICARBONATE		S
TORQ-TRIM	Biodegradable, non toxic lubricant	N
WALLNUT	Nut hulls	S
X-C POLMER	Biopolysaccharide gum	S
ZIOGEL	Attapulgite clay	S

N - Normal Mud Constituent
S - Special Mud Constituent (for specific well problems)

Source: U.S. Environmental Protection Agency, 1981

TABLE IV.A.3-3
STANDARD MUDS

MID-ATLANTIC BIOASSAY PROGRAM

*Mud Number #2 - Seawater Lignosulfonate Mud

Composition

Components	Concentration lbs/bbl	Concentration wt%
Barite	176.0	35.0
Bentonite/Drill Solids	32.1	6.3
Chrome Lignosulfonate	1.8**	0.4
Lignite	0.9**	0.2
Drispac (Polyanionic cellulose)	0.2	0.0
Salt	10.0	2.0
Caustic	0.9	0.2

Properties

Mud Density	12.1 lbs/gal
Percent Solids (Wt%)	43.5%
Calcium	650 mg/l

Metals Analysis

Metal	Concentration (ppm - whole mud basis)
Arsenic	2.0
Barium	141,000
Cadmium	1
Chromium	227
Copper	11.3
Lead	1
Mercury	1
Nickel	7.5
Vanadlum	18
Zinc	181

*Flowline mud samples obtained from Ocean Victory, OCS-A-0028 #3 WC: operator-Texcao. Collected March 16, 1980. Stored in refrigerator at EG&G until analysis by bioassay contractors.

**Estimated concentrations outside range for chrome lignosulfonate (2-15 lbs/bbl). lignite (1-10 lbs/bbl).

Table IV.A.3-3 (continued)
STANDARD MUDS
MID ATLANTIC BIOASSAY PROGRAM

*Mud Number 7 - Lightly Treated Lignosulfonate Freshwater/Seawater Mud

Composition

Components	Concentration lbs/bbl	Concentration wt %
Drill Solids	40	12
Bentonite	25	6.2
Barite	9	2.2
Chrome Lignosulfonate	4	1.0
Lignite	5	1.2
Cellulose Polymer (Drispac)	0.5	0.1
Chlorides	7500 mg/l	1.1 (NaCl)
Extractable Organics	0.8 mg/g	

Metals Analysis

Metal	Concentration (ppm - whole mud basis)
Arsenic	1
Barium	11,500
Cadium	1
Chromium	265
Copper	26
Lead	24
Mercury	1
Nickel	6
Vanadium	0
Zinc	82

Properties

Percent Solids (wt%)	24.1%
Mud Density	9.6 lbs/gal
pH	10.8

*Flowline mud sample obtained from Alaskan Star Drilling for Exxon USA in Block 599, Exxon OCS A-0029 Well #1

Table IV.A.3-3 (continued)

STANDARD MUDS
MID-ATLANTIC MONITORING PROGRAM

*Mud Number 8 - Lignosulfonate Freshwater Mud

Composition

Components	Concentration lbs/bbl	Concentration wt%
Barite	15.1	3.9
Bentonite	15.1	3.9
Drill Solids	28.1	7.2
Chrome Lignosulfonate	1.7**	0.4
Lignite	2.8	0.7
Caustic	1.2**	0.3
Lime	Trace	-

Properties

Mud Density	9.3 lbs/gal
% Solids (by wt)	16.4
Chlorides	1800 mg/1
pH	9.0
Calcium	40 mg/1

Metals Analysis

Metal	Concentration (ppm - whole mud basis)
Arsenic	3
Barium	14,000
Cadmium	1
Chromium	48
Copper	4
Lead	9
Mercury	1
Nickel	8
Vanadium	18
Zinc	15

*Flowline mud sample obtained from South Allenhorst Prospect, Caney Field C.R. Bostwick and Brotherton Survey A-6, Hatagora County, Texas. Collected November 16, 1980 by PESA.

**Estimated concentrations outside range for Chrome Lignosulfonate (4-15).

Source: U.S. Environmental Protection Agency, 1981

The discharge of deck drainage falls under NPDES permit regulations which specify there should be no discharge of free oil which would cause a film or sheen or a discoloration on the surface of the water or cause a sludge or emulsion to be deposited beneath the surface of the water (40 CFR 435). In compliance with this requirement, contaminated deck drainage is collected by a separate drainage system and treated for solids removal and oil/water separation. The oil is then held for shore disposal.

Sanitary wastes from offshore oil and gas facilities are composed of sewage and domestic waste such as kitchen and general housekeeping wastes. It is estimated that 6,000 gallons per day of sanitary waste are discharged from a typical exploration vessel and 5,000 gallons per day from a development platform (FEIS OCS Sale No. 49).

Sewage discharges are regulated by the EPA, as acknowledged under USGS Order No. 7. The EPA requires that the effluent be treated prior to discharge into the ocean such that it not contain any constituent in concentrations which exceed EPA's marine water criteria (EPA, 1976), and that it have a minimum chloride residual of 1.0 mg/l, maintained as close to this concentration as possible (40 CFR 435). Accordingly, the potential exists for the generation of trace quantities of chlorinated compounds.

Pipeline installation causes the resuspension of sediments into the overlying water column. It is estimated that between 4,000 and 8,000 cubic yards of sediment per mile of pipeline would be disturbed during installation. The composition of resuspended sediments will be site-specific. However, due to the large extent of sandy substrate on the Continental Shelf it can be assumed this would be the primary component entering the water column of the Shelf. On the Slope a higher proportion of silt and clay, characteristic of that substrate, would enter the water column during installation.

4. Air Emissions

National ambient air quality standards have been established for seven major pollutants that endanger human health and welfare. These pollutants related to OCS exploration and development activities are carbon monoxide (CO), particulates (TSP), sulfur dioxide (SO_2), hydrocarbons, photochemical oxidants (ozone, O_x), and nitrogen oxides (NO_x). In addition, New York and Rhode Island have established standards for hydrogen sulfide (H_2S), which may also be related to OCS activities. The various air quality standards define the maximum pollutant concentrations that can occur without impacting human health and welfare.

A major oil spill could release hydrocarbons and, if ignited, other materials such as oxides of sulfur and nitrogen into the offshore atmosphere. A major natural gas release could locally emit toxic amounts of hydrogen sulfide (H_2S) and also hydrocarbons into the atmosphere. These emissions, however, would probably be diffused rapidly in the offshore air mass. Also, to date there is no indication that hydrogen sulfide pockets are present within the proposed Sale No. 52 area.

Pollutant emissions during exploration occur largely from ship engines, gas flaring, drilling and routine supply operations. Major pollutants include NO_x, CO, TSP, and hydrocarbons.

The major offshore pollutants associated with production are sulfur oxides and nitrogen oxides from power generation, and hydrocarbons due to evaporative losses from oil spills as well as from routine operations such as tanker loading and off-loading. A combination of platform installation and high production levels normally results in a peak emission year occurring shortly after production begins. Offshore emissions decrease abruptly following completion of platform installation and continue to gradually decrease thereafter as production levels decline.

Power generation may account for up to 20 percent of the total OCS development-related emissions of nitrogen and sulfur oxides. Production emissions associated with pipelines include exhaust emissions from pumps to move the recovered oil and gas to shore, and evaporate hydrocarbon emissions from pipeline valves, flanges and seals.

Onshore supportive activities would be needed during all phases of OCS activities. The major onshore emissions source would be a gas processing plant. Generally, about 80 percent of the total onshore hydrocarbon emissions and lesser amounts of SO_2 and H_2S emissions are associated with processing plants. The major source of SO_2 emissions is the combustion of coal, oil and other commercial and industrial fuels containing sulfur.

Other sources of onshore air emissions include port facilities, tanker and barge engines, support bases, pipecoating yards, employee vehicles, helicopters, partial oil-processing facilities, and storage tanks. Potential environmental impacts from operating onshore service bases include hydrocarbon emissions from the storage and transfer of fuel for service vessels and offshore operations; and combustion from machinery and vehicles. For pipecoating activities, potential environmental effects stem from dust and other particulates, and internal engine combustion.

5. Oil Spills and the Oilspill Trajectory Analysis Model

Oil spills are one of the major concerns associated with exploration, development, and production of offshore hydrocarbon resources. Yet, oil is not a foreign substance in the marine environment.

Of the amount of petroleum hydrocarbons introduced into the oceans, river runoff and the atmosphere contribute 26% and 10%, respectively. Another 10% comes from natural seeps. Offshore production accounts for approximately 2% of the total input; although not insignificant, this is certainly a small amount on a relative basis (Lasday, 1978).

Recent reports on the presence of oil in the oceans of the world suggest that natural seepage may contribute almost double the amount of oil previously estimated to come from this source. The National Oceanic and Atmospheric Administration (NOAA) found an oil-rich layer approximately 700 nautical miles northeast of the Antilles. This oil-rich layer was estimated to be some 800 nautical miles long, and to contain an amount of crude oil close to one million tons. At approximately 200-m depths, the concentrations of crude oil in this layer were between three and 12 milligrams per liter of seawater. The location of the natural source of this oil was believed to be in the southern Carribbean sea (Ocean Science News, October 22, 1979; Coastal Zone Management, October 24, 1979).

An important fact that stands out when one attempts to evaluate the significance of accidental oil spillage due to offshore oil production in any proposed or existing lease area is that the problem is fundamentally probabilistic.

A great deal of uncertainty exists about the number and size of spills that might occur during the life of production as well as the wind and current conditions that would exist and give direction to the oil slick at the specific times spills occur. While some of the uncertainties reflect incomplete and imperfect data, considerable uncertainty is simply inherent in the problem of describing future events over which complete control cannot be exercised. In view of this, it is important to consider the range of possible effects that could accompany oil and gas exploration and production on the North Atlantic Outer Continental Shelf. In attempting to

maintain perspective on the problem, it is equally important to associate these potential effects with quantitative estimates of the probability of their occurrence.

To aid in estimating the environmental hazards of developing oil resources in OCS lease areas, the U.S. Geological Survey developed the Oil Spill Trajectory Analysis Model (OSTAM). The Model consists of a mesh superimposed on a base map of the study area, in this case the North Atlantic region. The maximum size of the mesh is 480 x 480 cells with each cell representing an area approximately 2 to 4 km2. Each cell contains information as to whether land is present or absent, presence or absence of vulnerable resources (targets), and identification of a wind station and of the ocean current system for determining the appropriate vectors for oil spill movement. One-point trajectories represent the path followed by oilspills moving under the influence of the wind and current system characteristic of each cell. Thousands of these trajectories were computed, and the conditional probabilities associated with their likely paths represent degrees of vulnerability of the various targets to an oilspill. For a realistic simulation of this vulnerability, targets should be at least 25 to 30 miles in extent. When smaller targets are considered (dumpsites, etc.), they are assumed to be at least 25 miles in extent; the results in these cases show greater vulnerability of the target than in the actual case. Entrance to bays (Raritan Bay, Delaware Bay, etc.), inlets and the mouth of rivers are not resolved by the model; trajectories stop upon contact with these features. Thus, impacts within the confines of bays, sounds, estuaries, rivers, etc., are based on subjective interpretations.

To determine conditional probabilities, it is assumed that a spill has already occurred. Thus, the chance that a target is contacted is determined by winds and currents only, and not by also considering the probability of whether a spill will occur. For a more detailed explanation of the model see Smith, et al., 1980.

A brief discussion of the analysis obtained when the model was used to aid in estimating the hazards of OCS development of oil resources that could result from proposed Sale No. 52 follows. Tables and figures mentioned in this discussion can be found in Appendix D.

Figure 2 shows the proposed lease tracts in Sale No. 52 subdivided into 12 groups, P1 through P12. In Figure 3 the existing lease tracts, a result of Sale No. 42, and tracts to be offered in proposed Sale No. 59 are shown grouped in two sets: P13 through P16, and P17 through P34, respectively. Figure 4 shows hypothetical and existing tanker routes in the Mid- and North Atlantic regions; these transportation routes are labeled T1 to T80. Figure 5 shows the Mid- and North Atlantic shoreline divided into 35 segments of approximately equal length.

When estimating probabilities of oil spill occurrence the basic assumptions were: 1) realistic estimates of future spill frequencies can be based on past OCS' experience, 2) spills occur independently of each other, and 3) spill rate is dependent on volume of oil produced and handled.

The estimated volumes for oilspill risk calculations in proposed Sale No. 52 area are based on those derived by the Conservation Division, U.S. Geological Survey. For the entire proposed Sale No. 52 area, three estimates of oil resources were made: Low, mean, and high volumes. If oil is present, an estimated conditional mean value of 1.73 billion barrels may occur.

In addition, two other mean resources estimates were made: 1.59 billion barrels for the proposed Sale No. 52 area tracts in the 0 to 2,000 meter depth range, and 1.42 billion barrels for the proposed Sale area in greater than 200 meter water depths. These additional mean resources were chosen so that deep water and fisheries deletion alternatives could be considered.

It should be emphasized that the oilspill risks discussed in this analysis are based on estimated volumes assuming that oil is present. If oil is not present (a 60 percent probability for proposed Sale No. 52 area), then no oilspill risk exists. This analysis is designed to answer the question, "What are the risks if oil is found?"

As for previous sales, the analysis for proposed Sale No. 52 has been conducted in three parts: the probabilities of oil spill occurrence; the trajectories followed by oilspills from hypothetical launch points to vulnerable targets; and then, combining these results, the probabilities that represent the overall risk associated with the proposed action; the latter are referred to as the joint probabilities.

One of the basic assumptions in this analysis - that spill rate is a function of the volume of oil handled - might be modified on the basis of size, extent, frequency, or duration of the handling. The various spill rates used in this analysis for spills greater than 1,000 barrels in size were: 2.05 spills per billion barrels in the case of platforms, and 3.87 spills per billion barrels for tanker transportation. For spills greater than 10,000 barrels in size, the rates used were 0.91 and 2.32 spills per billion barrels for platforms and tankers, respectively.

Table 1, Appendix D, presents a break down of the expected number of spills (the mean) estimated to result from existing and proposed leases, and from transportation routes (existing and hypothetical).

Assuming a 30-year production life, the expected number of spills from the proposed action is approximately 10. It is approximately 11 spills if the mean estimated volume of resources for proposed Sale No. 52 and for previous leases in the area (Sale No. 42) are combined. The only slightly higher number of expected spills when the estimates are combined is a reflection of the relatively low estimates of hydrocarbon resources (0.193 billion barrels of oil) associated with the existing leases in the North Atlantic region. In the Mid-Atlantic, the expected number of spills from existing leases (Sales No. 40 and 49) and from proposed Sale No. 59 is approximately 13.

Tables 3 through 14 give the relative risks (in percent chance) that one or more vulnerable resources, targets, or shoreline segments (Appendix D, Figure 5) may be contacted by an oilspill assumed to have occurred at a particular location (tract groups P1 to P34), or along any of the hypothetical or existing transportation routes (T1 to T80).

Furthermore, the probabilities are given for three time periods: 3, 10, and 30 days. Although the Model does not explicitly accounts for evaporation, weathering, and degradation of the spilled oil - these three time periods allow for some consideration of the toxicity of the oil at the time of contact with a target.

Tanker transportation of the oil produced from this proposed Sale means some targets and land segments have higher chances of being affected by oil spills, particularly from tankers bound for the Raritan Bay facilities.

Combining the chance that oilspills may occur with the chance that they may contact vulnerable resources gives an indication of the overall risk from this proposed Sale. Assuming tanker transportation, the probability that a spill would occur and contact vulnerable resources ranges from less than 0.5 percent to 97 percent for the target identified as Georges Bank Crest. The boundary of this target is roughly defined by the 60-m isobath; seven tracts included in the proposed Sale are within the boundary of this target. Thus, any assumed spills in this group of tracts implies a contact of the target by the spilled oil.

The hypothetical spill locations T1 through T80 represent routes that existing tanker traffic of crude oil and refined products use. The mean expected number of spills from existing transportation is 93. These spills are projected to occur over the next 30 years, if the proposed Sale is not held. Due to the high number of expected spills and the fact that many of them would occur close to shore along transportation routes, the probabilities that vulnerable resources would be affected are generally much higher than from the proposed Sale.

Summary: The leasing of the tracts in proposed Sale No. 52 may result in 10 oil spills greater than 1000 barrels if tanker transportation of the oil is used. Spills occurring in the proposed lease area have less chance of contacting nearshore or onshore vulnerable resources than those occurring along transportation routes.

The cumulative impact from adding in the previous North Atlantic sale is negligible because so little oil is expected to be produced from existing leases that it changes only slightly the expected number of spills.

Existing tanker transportation of imported crude oil and refined petroleum products in the Mid- and North Atlantic is expected to result in 93 oil spills greater than 1000 barrels over the next thirty years. To the extent that oil from proposed sale No. 52 replaces imported oil, the risk associated with the proposed sale would be substituted for the risks associated with the transportation of oil imports.

B. Effects of the Physical Environment on Oil and Gas Operations in the North Atlantic

1. Geology

The USGS defines hazards as geologic conditions that have a high inherent risk and may be hazardous to oil and gas explorations and development operation; not identifying, avoiding, or taking proper engineering precautions against them could have dangerous consequences. Hazards may be particularly dangerous owing to their often upredictable mode of failure. Constraints are conditions which, once identified, can be alleviated or minimized through the use of existing standard design and engineering technology (Hall and Ensminger, 1979).

Swismic Risk and Shallow Faulting

The Georges Bank Basin region is an area of relatively little seismic activity as is the entire Continental Shelf and Coastal Plains of the eastern United States. Visual No. 3 shows the approximate epicenters of seismic events since 1800 as indicated by Hadley and Devine (1974). Recorded offshore earthquake epicenters on the southeastern New England Continental Shelf and Slope are rare. The onshore areas have generally experienced moderate to high frequencies of low intensity activity (Modified Mercalli II to VI), although a good protion of the New England onshore area has experienced intensities as great as MM VII or greater (Arron and others, 1980; Hadley and Devine, 1974). MM VII is the threshold of damage in buildings of relatively good design and construction. A recent probabilistic study of earthquakes on the United States East Coast and adjacent Outer Continental Shelf theorizes that increased activity since 1940 might indicate an upswing in seismic activity in southern New England (Perkins et al, 1979).

Although confident predictions of future seismicity in the proposed sale area are virtually impossible, geologists believe the seismic risk is minimal. Aaron and other (1980) suggest that the paucity of epicenters on the Continental Shelf and Slope off New England provide no evidence to extend onshore seismic trends through Georges Bank. The major faults and tectonic trends suggested through geophysical data interpretation do not appear to be a source of offshore seismic activities. In addition, high resolution geophysical data collected on Georges Bank for OCS Sale No. 42 suggests that the deep faults encountered in the profiles (depth range below the sea floor of approximately 260 to 375 m) have been inactive since the Triassic or Jurassic (Hall, 1979). Recent and historical data, therefore, imply a relatively low earthquake risk in the Georges Bank area.

Surface or near-surface expressions of shallow faults on the OCS may also present hazards. Movement of surficial faults can result in shifting and/or structural damage to oil and gas equipment and facilities. Shallow faults can serve as conduits for shallow high-pressure gas, implying possible cratering or liquefaction of foundation sediments. Mass movement or differential compaction within the unconsolidated sedimentary section may trigger gravity-induced shallow faulting, serving as an indication of possible slope failure or potential sediment instability (Carpenter and Roberts, 1979).

The USGS considers faulting within an unconsolidated sedimentary section to be a hazard because these features are apparently generated in response to relatively recent or contemporary stresses. Recent seismic surveys over the Georges Bank Shelf and Slope have not revealed any widespread evidence of shallow faulting. Aaron and others (1980), however, note that minor faulting within the upper 20 to 80m of unconsolidated sediment could be difficult to detect due to poor seismic resolution of the survey systems employed and the lack of continuous stratigraphic reflecting horizons.

Shallow Gas Deposits and Gassy Sediments

The presence of shallow gas concentrations could result in foundation failure beneath a drilling platform, or in the blow-out of a well. Gas may be found as confined, isolated accumulations with higher than ambient pore pressure (shallow gas deposits), or at the sediment surface as natural seeps and gas-charged mounds (gassy sediments).

Shallow deposits of gas significant enough in concentration to be considered a hazard are rare on the shelf and slope of the proposed sale area. The presence of shallow gas deposits may be indicated by two means: 1) bright spots on geophysical records (much stronger than usual seismic reflections for a limited distance from a sediment surface) (Coffeen, 1978) and 2) actual laboratory analysis of cored samples.

High-resolution geophysical data obtained from the shelf in the vicinity of Georges Bank has not revealed any widespread deposits of shallow gas.

Hazards analyses for OCS Sale No. 42 detected only one bright spot covering an area approximately 2.6 km long and 300 m wide and lying at a depth of 60m below the sea floor (Hall, 1979). In addition, seismic data obtained before drilling of the COST G-1 and G-2 wells did not reveal any shallow gas deposits. In actual operation, neither well encountered any significant deposits of gas-charged sediment lenses (Adinolfi, 1980; Jacobson, 1980).

Analysis of cored samples obtained during the Atlantic Margin Coring Project did not reveal any significant amounts of methane, ethane, or propane on the shelf, although a sample obtained near Hydrographer Canyon in approximately 244m (799 ft.) of water did show traces of light hydrocarbons. Methane concentrations as great as 339 x 103 ppm occurred in two major zones of the core, the first from 60 to 90 meters, and the second from 190 to 290 meters (Hathaway et al, 1976). Ethane and propane were also present in the cored sample. However, a similar sample obtained near the east side of Lydonia Canyon in 209m (686 ft.) of water upon analysis revealed no light hydrocarbons were present.

A study of residual interstitial gas deposits on the North Atlantic Slope has been recently completed by USGS-Woods Hole under contract to the Bureau of Land Management (Miller et al, 1980). Eight piston core samples obtained from the Georges Bank area were analyzed to determine concentrations of various light hydrocarbons. All were determined to have very low concentrations of methane, ethylene, and ethane, typically less than 10 ppm (volume gas/volume sediment). In addition, unlike samples obtained from the Mid-Atlantic Slope, there was no detectable increase of residual gas concentration with increasing depth of burial. Therefore, Miller et al (1980) do not consider shallow gas to be a geological hazard on the North Atlantic Continental Slope.

Gassy sediments are commonly present throughout the Mid-Atlantic OCS, but no indication exists that they are present in the North Atlantic (Hall and Ensminger, 1979). Gas seeps, commonly seen as trains of bubbles rising through the water and bursting at the surface, have not been reported in the Georges Bank area. Emery (1976) attributes this to two main factors: 1) the failure to find buried marsh silts and clays that could serve as sources or traps for the gas; 2) the high permeability of the sediments on Georges Bank allows any marsh gas that is generated to escape as rapidly as it forms and thus no gaseous accumulation can take place. This may be true for the shelf area, but the silt-clay sediments found on the slope could possibly contain some gassy deposits such as are found in the Gulf of Maine and Scotian Shelf. However, the work of Miller et al (1980) would tend not to support this conclusion.

Gassy sediments are considered constraints to oil and gas development, rather than a hazard. Given the correct parameters as to gradient, gas concentration, sediment compaction and porosity, these sediments, when subjected to cyclic loading, cna spontaneously liquefy. The possibility of all these appropriate conditions being simultaneously present in one area on the Atlantic Continental Shelf or Slope, however, seems remote.

A condition similar to that of shallow gas, is hydrated gas. A gas hydrate is an ice-like, crystalline lattice of water molecules in which gas molecules are physically trapped (Tucholke, Bryan, and Ewing, 1977). Several papers have cited the existence of anomalous seismic reflections as being indicative of gas hydrate horizons on the Atlantic Slope (Tucholke, Bryan and Ewing, 1977; Shipley et al, 1979). In addition, McIver (1977) has predicted that gas hydrates are probable wn the first hundred meters of sediment in water depths greater than 300 m (1000 ft.). Increased pressure stresses caused by hydrate decomposition may trigger sediment slides or mud diapirs. However, USGS geophysical and sampling data do not support the existence of hydrated gas on the Atlantic Shelf or Slope (Hall, 1979; Hall and Ensminger, 1979; Miller et al, 1980).

H2S or sour gas (hydrogen sulfide) is a potential hazard to drilling operations. This poisonous gas, also highly corrosive to steel structures, is not anticipated to be significant threat on the North Atlantic OCS. The COST G-1 and G-2 well analyses, as well as other studies, have not identified the presence of any significant amounts of H2S. In addition, no problems with H2S have been reported in drilling on the Scotian Shelf north of the Georges Bank area (Jacobson, 1980).

Erosional Forces and Mobile Bedforms (Sand Waves)

Strong bottom current activity can pose a potential hazard to oil and gas structures in the form of scour or sand waves. Scouring is a process of sediment erosion by the action of flowing water (Aaron and others, 1980). The removal of sediment from the base of support structures, such as fixed platforms or pipelines, can result in weakening or differential settlement of the structure. In addition, the actual placement of the structure may alter the bottom currents in such a manner as to induce increased erosion, exposing additional structural surface area. Deposition of excessive sediment around the supporting members of a structure could also change the resonant frequency for which it was designed, resulting in weakening of the structure (Lewis et al, 1980).

The theoretical sediment threshold velocity required to transport fine sand is 25 cm/sec. Aaron and others (1980) report bottom current speeds ranging from 10 to 30 cm/sec in water depths of 85m on Georges Bank. Thus, frequent bottom sediment motion could be expected in this area. Bottom currents are particularly pronounced on shallower portions of the Bank (within the 60m

isobath) where tidal currents aid in frequent reworking of surficial bottom sediments. Near-surface tidal currents near the crest of the bank are typically 75 cm/s and about 35 cm/sec on the north and south flanks of the Bank (Aaron et. al, 1980).

The mean bottom current speed at 35m water depth during the period 23 April to 15 August, 1978, was approximately 56.4 cm/sec (EG & G, 1979a). Only 7 tracts selected for proposed Sale No. 52 lie within the 60m depth contour.

Scour occurred around a railroad wheel placed on the sea bottom in 85 meter water depths near the abandoned G-1 COST well location (Hall, 1979). However, a railroad wheel placed at another location revealed no scour was taking place, indicating non-uniform current velocities and erosional processes over the Bank. Contrary to the report by Emery and Uchupi (1972) that scour caused the removal of the Texas Towers on Georges Bank, Rutledge (Mueser, Rutledge, Wentworth and Johnston Consulting Engineers, personal communication to BLM, 1975) states that they were salvaged because the military radar systems were obsolete, scour never being a problem. Texas Tower #4 (located offshore Long Island) collapsed after a major storm, but Rutledge attributes the failure to damage caused to the structure while being towed from port (before emplacement); subsequent repair efforts to the damaged support had been unsuccessful. Poor scour preventive design features caused the Sedco H semi-submersible rig to abandon operations in 30m (98 ft) of water on the Scotian Shelf after a major storm threatened the stability of the vessel (Wilson and Abel, 1973). Proper matting over the pontoons or choice of a different drilling rig would have alleviated the problem.

Although scour may be considered a constraint to oil and gas development on the shallower portions of Georges Bank, it would not appear to be significant in deeper waters. Bottom current measurements at a water depth of 200m indicated mean speeds of 16.9 cm/sec during the period 29 January to 30 April, 1979 (EG&G, 1979). Although bottom current speeds of 29 cm/sec or slightly greater were reported during the winter months (EG&G, 1979b), current velocities necessary for the transport of the very fine-grained material found on the outer shelf, slope, and rise are significantly greater than those required for coarser material. Grain size in itself may not necessarily provide the basis for determination of threshold velocity (Keller, Lambert and Bennett, 1979). As sediment grains become finer, they generally tend to become more compacted and cohesive. In addition, properties such as water content, organic content, mineral composition, and amount of biogenic reworking may influence the threshold velocity of fine-grained cohesive sediments (Southard, 1979).

As an example, McGregor (1979) reported bottom current velocities as great as 30 cm/sec on the mid-slope between Baltimore and Washington Canyons. Keller, Lambert, and Bennett, (1979), however, question whether these velocities exceed the threshold velocity of the fine-grained (.008 mm median diameter) deposits found there and cite bottom photographs from a mid-slope area nearby showing

no erosional evidence of bottom current activity. Current velocities of 70 cm/sec have been measured in the slope area between Alvin and Block Canyons, but no evidence of erosion or sediment transport was reported. Also, Booth, Farrow, and Rice (1980) report no evidence of scour at an intercanyon geotechnical sampling site (1600m water depth) near Alvin Canyon. The occurrence of ripples has been noted in canyons off Georges Bank, indicating some sediment transport is taking place in the canyons (Shepard et al, 1979; Valentine, Uzmann, and Cooper, 1980).

In summary, scour may be a constraint on shallower portions of Georges Bank (tracts in water depth less than approximately 100m), but would not appear to be so on the outer shelf, slope, or rise due to weak bottom currents and cohesiveness of the very fine-grained sediments found there. Proper engineering precautions should be taken in areas where scour can be expected.

Bottom current regimes also play a role in the formation of sand waves on the seafloor. The presence of sand waves, particularly those which are mobile, present the potential problem of sand piling up against a supporting member of a fixed structure. Excessive loading of sand on such a member could result in major structural stresses and possible failure or changes in resonant frequencies.

The majority of sand waves found in the Georges Bank Region lie in water depths of 60m or less (see Visual No. 3). As mentioned previously, only 7 tracts selected for study lie within the 60m contour. The sand waves found within this area are sharply asymmetrical, suggesting possible migration (Aaron and others, 1980). Stewart and Jordan (1964), however, report that only those sand waves in water shallower than 40m appear to be moving, as a consequence of combined tidal currents and passing water waves. There are no tracts selected for proposed OCS Sale No. 52 lying in water depths as shallow as 40m. In addition, Emery (1976) noted that tracts selected for OCS Sale No. 42 were located in a belt of smooth topography. The large majority of the tracts being studied here that lie on the inner and mid-shelf regions are located in the same general region. Thus, sand waves would appear not to be a constraint to oil and gas development in the proposed lease area.

Foundational Stabilities, Geotechnical Properties and Mass Movement of Sediment

The foundational stability of offshore oil and gas structures is governed partly by the geotechnical properties of the sediment underlying the structure. These properties influence not only the site of placement of drilling sturctures, but how these structures will be affected after placement (i.e. shifting, sinking, etc.).

The Georges Bank Continental Shelf is blanketed by a surficial sand sheet of Pleistocene age, deposited by glaciers and glacial melt water during the Ice Age. This material may be up to 80m thick on some portions of Georges Bank and was reworked during the sea-level rise which accompanied the termination of the last glacial stage (Aaron and others, 1980). Present day waves and currents continue to modify and rework the sand sheet.

Geotechnical studies of core samples obtained on the Georges Bank Shelf indicate that the sandy material seems to have the structural properties necessary to support drilling equipment (Richards, 1978; Swanson and Brown, 1978). Aaron and others (1980) point out that the geotechnical properties of the cores obtained during the Atlantic Margin Coring Project were not unusual in range or distribution and exhibit properties comparable to the properties of similar material in the emerged Coastal Plain of the eastern United States. Emery (1976) believes that the sediments found on the Bank and outer continental shelf should have adequate bearing strength for supporting production platforms and other structures required for offshore production of oil and gas.

Several foundational problems theoretically could be encountered, however, on the Georges Bank Shelf. The loose surficial sand found on the shelf may be susceptible to liquefaction. Sangrey and Knebel (1979) have pointed out that the loose surficial sand of the Mid-Atlantic Shelf, being predominantly uniform fine-grained material, is among the most vulnerable to liquefaction under drained cyclic and dynamic loading. Although the sand on Georges Bank tends to be coarser grained than the Mid-Atlantic area, the possibility of liquefaction occurring cannot be entirely ruled out, particularly in light of the intense current and wave regime present.

High-resolution geophysical data indicates that several episodes of channel cutting and filling have apparently taken place on the shelf (Aaron and others 1980; Lewis et al, 1980; Hall, 1979; Schlee et al, 1979) (See Visual No. 3). Channel fill material generally shows unusual amounts of internal variability in sorting, texture, porosity and load-bearing capacity, owing to the fact that it was deposited in a high-energy depositional environment (Carpenter and McCarthy, 1980). The channels were originally cut when rivers flowed out onto the shelf during Pleistocene periods of low sea level and were later buried under great loads of sediment during the transgressional eras.

These structures tend to be areally small and well-defined, resulting in contrasts in consolidation and load-bearing capacities over short horizontal distances. Thus, the large contrast in bearing capacity between the infilling channel deposits and the surrounding sediments could result in the tilting of bottom-mounted structures which are straddling the boundary between the two types of sediment (Hall, 1979). Hall (1979) also points out that coarse-grained channel fill deposits can cause "lost-circulation" (drilling fluid loss) during drilling. Another possible constraint on the shelf may be the occurrence of pockets or lenses of low to moderate strength material in the surficial sediment. Core samples obtained during siting studies for two Texas

Towers encountered lenses of silts and clays up to 14 meters thick (45 feet) beginning at depths of 18 to 27 meters (60 to 90 feet) beneath the seafloor. Some cores obtained by the U.S. Geological Survey during the Atlantic Margin Coring Project contained silty clay layers up to 20 meters thick (65 feet) beginning at depths of 50 m beneath the seafloor. Keller (1977) has pointed out that the limited lateral extent of low strength sediment lenses allows for the possibility of finding sand at the site of one leg of a structure and clay or silt layers at the other legs, which could pose potentially serious stability problems for offshore structures erected upon them.

Recent seismic reflection profiles taken over Georges Bank by USGS-Woods Hole support the fact that the properties of the shallow sediments are complex, variable, and change dramatically over short distances, in both lateral and vertical planes (Aaron and others; Lewis et al, 1980; Schlee et al, 1979). Features such as filled channels, unstable shelf sediments or lenses, etc. are considered, however, to be developmental constraints to oil and gas development (Hall, 1979). Site-specific surveys and subsequent accommodation by existing standard design and engineering technology should help alleviate these concerns.

Unlike the shelf, the North Atlantic Continental Slope sediments are composed of much finer material. The sediments of the North Atlantic Slope, however, tend to be coarser-grained than the material found on the Mid-Atlantic Slope. While the mid and lower portions of the Mid-Atlantic Slope are dominated by clayey silts and silty clays (within the uppermost three meters of sediment) and the upper slope material is commonly sands and silts, only the lowermost slope deposits of the North Atlantic Slope are silty clays. The upper and mid portions of the North Atlantic Slope are dominated by silty or clayey sands (Hathaway, 1971; MacIlvaine, 1973). Keller, Lambert, and Bennett (1979) cite the immediate vicinity of Alvin Canyon as being indicative of the marked change in sedimentation between the Mid and North Atlantic Slopes.

They also point out that reworked Pleistocene sand and gravels are commonly present on the uppermost portions of the New England submarine canyons and attribute the occurrence of the relatively coarse-grained deposits found on the North Atlantic Slope to the combination of strong bottom currents and a source of coarse-grained sediments on the adjacent shelf.

Recent studies by Keller, Lambert, and Bennett (1979) and Booth, Farrow, and Rice (1980, BLM ESP) use indices such as shear strength, sensitivity, water content, bulk densitiy, porosity, plasticity, etc. to evaluate the geotechnical and foundational stabilities of the slope sediments. In general, both studies found that the sediment properties are indicative of an area dominated by fine-grained silty and clayey material.

The geotechnical properties of the slope sediments generally indicate sufficient foundational stabilities for offshore structures. However, the properties also have implications regarding mass movement of sediment downslope. Mass movement of material is commonly referred to as slumps or slides. Slides are movements of essentially rigid, internally undeformed masses of sediment along discrete shear surfaces, while slumps are a form of slide movement occurring in a rotational manner (Nardin, et al, 1979). If movement of material is along a planar surface, the deposit would be termed a glide deposit. Complete definitions, classifications, and descriptions of these features can be found in Nardin et al (1979) and Lowe (1979).

Slumps and slides may be triggered by seismic events, but in the proposed lease area gravitational forces would seem to play a more important role. Apparent mass movement features on the North Atlantic Slope have been documented by Uchupi (1967); Roberson (1964); McIlvaine and Ross (1979); McGregor (1979); Valentine, Uzmann, and Cooper (1980); Aaron and others (1980); and by O'Leary and Twichell (1981).

Slumping apparently occurs when the shear stress along a potential surface of failure exceeds the shear resistance along that surface (Schlee et al, 1979). Aaron and others (1980) have cited the instrumental processes believed to induce slumping: 1) cyclic loading by storm waves or breaking internal waves; 2) dynamic loading by ground acceleration during earthquakes; 3) overloading or oversteepening of slopes by deposition of sediment; and 4) oversteepening of slopes by erosion.

Geologists and geophysicists are still debating, however, whether the slump features apparently present on the North Atlantic Slope are relict, deposited at a time of lower sea level, deposited as a result of present-day processes, or in some cases, not slump material at all. Certainly, the potential for mass sediment movement on the slope exists. Keller, Lambert, and Bennett (1979) have reported that mid and lower slope gradients off Georges Bank average 7°. Aaron and others (1980) have recently documented slope angles as great as 10°. In addition, the inclination may be nearly vertical at canyon or valley walls or at intercanyon areas having outcrops of consolidated rocks (Schlee et al, 1979). Valentine, Uzmann, and Cooper (1980) have reported the existence of apparent slump material in Oceanographer Canyon, resulting in unconformable relations between younger and older rocks. This unconformable relationship apparently results in the slumped strata dipping more steeply than the underlying beds.

The potential for present day sediment slumping on the Georges Bank Slope has been examined by Keller, Lambert, and Bennett (1979) independently, and by Booth, Farrow, and Rice (1980) of the United States Geological Survey under contract to the Bureau of Land Management. Both studies utilize the infinite slope stability analysis method for evaluation of slumping potential. This method assumes a constant slope of unlimited extent relative to the thickness of the sediment mass. Shear strength data are then used to assess the near-surface slope stability characteristics (Keller, Lambert, and Bennett, 1979).

This method has been documented by Taylor (1978), Morelock (1969), Almagor and Wiseman (1977), and Ross (1971), among others. The infinite slope analysis method does have limitations, however, mainly owing to the fact that it applies only to failure resulting from excessive loading of sediment on a sloping surface.

Using the infinite slope stability analysis method Keller, Lambert, and Bennett (1979), who analyzed 68 cores on the slope between Cape Hatteras and Hydrographer Canyon, determined that only 2 cores indicated possible failure might be expected to take place. Both of these cores were recovered from Mid-Atlantic submarine canyons, one being from Wilmington Canyon, the other from Hudson Canyon. In combination with the previously mentioned geotechnical data, the authors cite the sediments on the slope to be, for the most part, stable.

Booth, Farrow, and Rice (1980) concentrated their studies in the intercanyon areas immediately adjacent to Alvin Canyon. This survey zone lies directly on a portion of the proposed Sale No. 52 area. Utilizing basically the same approach as mentioned previously, the authors conclude that the surficial sediments represented by their core samples are stable with respect to mass movement. It should be emphasized, however, that the model assumes zero pore pressure and that various factors other than overburden probably play a role in the slumping of slope deposits (Keller, Lambert, and Bennett, 1979).

Booth, Farrow, and Rice (1980) carry the analysis one step further by computing consolidation states of their samples. This method utilizes mainly strength and plasticity data. Consolidation state partially infers stability as it reflects the presence of abnormal strength or weakness in a sediment column. Overconsolidation indicates relatively high strength, and hence stability under most circumstances. Standard strength is denoted by normal consolidation, implying stability at typical slope angles with no unusual sediment properties or outside forces being present, and underconsolidation implies weakness and probable sediment failure. Determination of these consolidation states indicated the sites represented by the cores were relatively overconsolidated and support the hypothesis that the surficial sediments are relatively stable. However, precise evaluation of the potential for mass sediment movement is difficult due to the limited penetration of the piston cores.

In many instances, features originally interpreted as slumps appear not to be so.

Robb et al (1981 -BLM ESP) studied a portion of the Mid-Atlantic Continental Slope between Toms Canyon and Lindenkohl Canyon. The survey area included several blocks which were deleted from OCS Sale No. 49 because of the apparent existence of slumped material. Details of the study may be found within the FEIS for Sale No. 59 (Mid-Atlantic).

Although the report dealt with the Mid-Atlantic Slope, the data points out how interpretations of geological processes may change upon collection of more detailed information. It is possible that previously documented slump areas on the North Atlantic Slope may be, in fact, topographic features similar to those found in the survey areas researched by Robb et al (1981). Indeed, Aaron and others (1980), who collected seismic data over Georges Bank which suggests that about 37% of the Continental Slope off New England may possibly be underlain by slump deposits, point out that slump features are extremely difficult to precisely identify in widely spaced tracklines oriented normal to the bathymetric contours.

Up until recent years data utilized in identifying slump features consisted mainly of widely spaced seismic reflection lines run normal to the bottom contours. The recent work done by USGS points out the necessity of collecting not only closer spaced seismic data, but also seismic data run parallel to the contours. Side-scan sonar data also aids enormously in precise and accurate analysis of continental slope processes such as mass sediment movement.

Preliminary interpretations of data collected on the Georges Bank Continental Slope indicate that slumping could pose a problem on the lower slope and upper rise of the proposed sale area. USGS-Woods Hole collected 8,340km of seismic profiles along the slope and outer shelf edge of Georges Bank in 1978 and 1979 (Aaron and others, 1980; O'Leary and Twichell, 1981). In 1979, long-range sidescan sonar image data was collected in the same survey area (roughly from 71°W. to Northeast Channel). In 1980 a detailed seismic survey of a 2800km area on the slope within to the lease sale No. 52 area between and including Oceanographer and Lydonia Canyons was completed. Profiles were spaced 1km along the slope and 5km down the slope. An oceanographic cruise later in the same year acquired mid-range sidescan-sonar images of the same area with a spatial resolution of about 3m. USGS-Conservation Division is presently analyzing tract-specific seismic data which will be available in time to be discussed within the FEIS. These data will not include the approximately 176 tracts lying on the shelf.

The data reveals that despite its low angle of declivity (3° to 8°) the Georges Bank Continental Slope is extensively and relatively deeply eroded with local slopes that commonly exceed 20°. O'Leary and Twichell (1981-BLM ESP) report that approximately 70% of the Continental Slope surface in the Lydonia and Oceanographer Canyons area is eroded. Most slope erosion is associated with the numerous submarine canyons.

The type of erosion appears to vary with depth on the slope. Near the top, between about 250m and 1000m, submarine canyons are fringed with wide areas of ridge and gully terrain in which networks of gullies are tributary to the central channels of the canyons. The canyons themselves are relatively wide, flat-footed features. They appear to be sites of deposition as well as erosion in that their bottom surfaces are generally smooth and featureless.

Below about 1500m, eroded forms of the slope are complex and not all of them are related to the canyon networks. Erosion appears to have occurred extensively within the last 200,000 years (based on submersible observations and bottom core samples) as a result of bottom current activity during the Late Tertiary glacial lowstands of sea level. Although erosion of the canyons has generally been ascribed to the action of turbidity currents, the diversity of erosional forms on the slope suggests complex erosional mechanisms have shaped and formed the canyons.

The slope of the bottom flattens out to an inclination of about 1¼ at the 2000m depth contour. This flatter surface, the upper Continental Rise, is built up of sediment brought down from the slope and shelf and is essentially a constructional surface. The canyons of the slope continue across the upper rise, and the deep, extended erosional features of the lower slope are also present (O'Leary and Twichell, 1981-BLM ESP).

O'Leary and Twichell (1981) report that preliminary interpretation of the seismic data indicates that slumped material is mainly present on the lower slope and upper rise of the Georges Bank region.

On the upper Continental Slope slumping appears to be localized and restricted mainly to the steeper portions of the submarine canyons. Along Veatch Canyon series of rubble covered terraces, 2 to 5m wide, separated by steep (75°) cliffs 1 to 3m high have been observed. The terraces appear to be slumps or wall segments that have slid out of place. Slater (unpub. data) has also observed shallow, straight features, 1m across and 25m deep, at the 180m contour near Veatch Canyon. He interprets these features to be rills (small, transient, troughlike hollows); at 200m depth they are as wide as 3m with hummocky, burrowed sides sloping 20 . These features do not, however, appear to be unstable.

Submersible observations by Slater (1980-BLM ESP) on the upper Slope region between Lydonia and Veatch Canyons support the preliminary conclusions reached by O'Leary and Twichell (1981). The intercanyon regions of the upper slope appear to be characterized by a relatively low relief, monotonous surface. Little or no slumping appears to be taking place within the area, except for small, localized slumping within the canyons, particularly near the canyon heads. This localized slumping is probably caused by oversteepening due to deposition and possibly even by local erosion along canyon and larger gully thalwegs (also called the valley line - a line connecting the lowest points along a valley).

O'Leary and Twichell (1981) also suggest that this localized slumping evident on the upper slope may be related to deeper sediment collapse on the lower slope. This lower slope collapse may lead to headward propagation of the canyon gradients. They point out, however, that significant examples of fresh, recent collapse have not been found, possibly indicating that slope

collapse occurs locally or regionally at widely spaced intervals of time. If slumping events do occur at intervals of centuries their hazard potential can be considered to be low. On the other hand, some morphological features observed on the mid and lower portions of the slope suggest that scarped slopes may be metastable, awaiting only an appropriate stress to trigger the collapse. Stress thresholds and mechanisms have not, as yet, however, been analyzed.

On the mid and lower portions of the Georges Bank Continental Slope (between depths of 1000 and 2000m) steep slopes bound the eroded terrain related to the canyons. Localized areas of apparent slump features mark relative, steep headwalls. Numerous scarps, terraces, incisions, reentrants and promontories, and rubble strewn lower slope surfaces indicate that the steep, etched slopes facing the canyon systems were formed partly by mass collapse and disintegration.

O'Leary and Twichell (1981) note that locally, the lower slope and bottoms of cirquelike depressions that open into canyon terrain show slight scarps that suggest that even relatively flattened slopes may be unstable within the etched terrain. They also note a relative lack of slump rubble on the lower slope, suggesting that mass sediment wasting results in nearly totally disaggregated debris that may be removed by turbidity currents and distributed on the upper rise, where it may be subject to local surficial sliding. The features also suggest that wall collapse is local and piecemeal and that slope erosion may involve grain-by-grain disaggregation or surface spalling following massive failure.

Slumping is apparently widespread in lower slope sediments that are known to be mechanically more stable than the Pleistocene sediments high on the slope, where slope collapse is local and minor. O'Leary and Twichell (1981) note, however, that because depositional oversteepening and turbidity currents are not apparent factors, gravitational processes unrelated to sedimentation appears to be the dominant erosional agent on the Continental Slope in the study area.

Sidescan-sonar images of the upper Continental Rise, between 2,000 and 2,500m depth depict a texturally uniform surface of low relief etched by polygonal scarps. The forms imply shallow, sheetlike slumping and disaggregation of relatively small areas along the slope-rise boundary. Such features are also implied in some seismic profiles which transect the upper rise. Smeared tonal variations in terrain adjacent to canyon axes on the rise imply that near-surface compositional variations are important in the development of erosional forms. A core obtained below 2,000m near the mouth of Powell Canyon showed thinly layered sediment of varied texture, color, and mechanical properties. The textural variations and the shallow scarps on the upper Continental Rise suggest that portions of the region between 2,000 and 2,500m may be potentially unstable and should be thoroughly tested for mechanical strength (O'Leary and Twichell, 1981).

Based on the preliminary interpretations of Aaron and others (1980) and O'Leary and Twichell (1981), a deletion alternative regarding tracts containing possible sediment slumps has been developed and included within the DEIS (see Section II.B). The tracts identified are subject to change depending on the final results of USGS's tract specific geological hazards analysis which will be completed in time for input to the FEIS.

Structurally Unstable Sediments on the Upper Continental Slope

O'Leary and Twichell (1981) describe a potentially unstable clay layer present on the upper Continental Slope within of the proposed sale area. The cohesive gray clay underlies the incised terrain of the upper Slope and is widely veneered by fine sand or silt as much as 10cm thick. The clay probably was deposited during an earlier period of erosion as a result of suspension on steeply gullied slopes. The earlier gullies appear to have been completely filled and some are reincised. The gully and rill network has been reestablished following depostion of the clay (within the last 20,000 years). The thickness of the clay unit is not known.

Valentine, Uzmann and Cooper (1980) estimate the total thickness of Quarternary sediments along the outer shelf and slope on either side of Oceanographer Canyon to be about 300m.

The sand and silty sand layer capping the outer shelf and upper slope is glacial outwash sediment deposited during the main phase of glacial retreat from the top and northern margin of Georges Bank. The underlying clay layer seems to be a widespread stratum that thickens with and follows the dip of the underlying slope. This clay layer apparently crops out below about the 250m isobath and dips downslope, as observed by Slater (unpub. data). The overlying outwash sediments pinch out at this depth. The association of scattered boulders and cobbles with the exposed clay suggests that the clay was deposited from melting pack ice and shelf ice in quiet water during the period of maximum ice stability on the shelf, just prior to the rapid retreat of the ice and consequent outwash deposition. Clay deposition abruptly ceased and the clay was rapidly buried by a blanket of relatively coarse, sandy sediment. This geological condition points to a potential hazard; the uppermost clay layer, dipping down the slope, may be overpressurized because of rapid burial. Structural footings that fail to penetrate the clay layer may induce loading phenomena that could result in foundational failure of the silty clay. There is some evidence in seismic profiles that creep has occurred in subsurface layers along the edge of the Continental Shelf off Georges Bank.

The Pleistocene clay exposed near Alvin Canyon was cored (Booth and others, in press) to determine its geotechnical properties. The cored sediment has a relatively high shear strength for surface sediment (average 9.5 Kpa) and

is very sensitive. Bulk density is higher (1.71 g/cc, average) and water content is lower (53%, average) than normal. Sediments failed by "plastic" shear at about 8 percent to 10 percent strain. Tests for shear strength and index properties suggest that the core sites near Alvin Canyon were once buried under 10 to 35m of overburden. However, slope stability analysis indicates that the cored sediment is stable (normal to slightly overconsolidated). The sediments have angles of internal friction between 21¼ and 28¼- typical values for fine-grained marine sediments.

Pleistocene sediments draped on previously eroded but stable slopes may have been locally oversteepened due to rapid sedimentation rates, and subsequently sloughed off. If this condition were widespread, many slopes may be metastable on the upper part of the Continental Slope today. (Detailed site-specific coring studies are strongly suggested in this region).

Potentially Mobile Surfaces on the Continental Slope

O'Leary and Twichell (1981) note that fine sediment winnowed from the glacial outwash of the shelf surface is distributed as a rippled surficial layer on the upper Continental Slope. Observers agree that this winnowed sediment is being transported to the floors of the canyons where it apparently concentrates (Valentine, Uzmann, and Cooper, 1980; Slater, unpub. data). Stanley and Freeland (1978) concluded that the transport ceases to be effective below about 175m water depth. Valentine, Uzmann, and Cooper (1980) noted that the "mud line" (the approximate boundary between erosion, or transport, and depostion, or stability) has not been recognized along the east slopes of the submarine canyons, where coarser, rippled surfaces extend to greater depths. The different surface textures on the east and west wall suggest that currents are much more effective at transporting sand along and down the east walls than over the west walls. Valentine, Uzmann and Cooper (1980) also noted that sediment on the canyon walls appears to move along the walls rather than directly downslope into the axes.

Below the "mud line" in the Alvin Canyon area the fine-grained sediment surface shows surprising resistance to erosion. Experiments conducted by MacIlvaine and Ross (1979) on surface samples obtained at 1,800m depth showed that current velocities of 150 cm/s were required to slightly modify the surfaces. The MacIlvaine and Ross experiments suggest that mass erosion focused at surface irregularities may be the dominant mode of bottom current erosion on the lower Continental Slope. However, they noted that the surface may be smoothed of perturbing irregularities by epibenthic fauna and infauna. Further, small annelids appear to establish an intricate network or mat of fibrous binding material associated with their burrows near the surface. MacIlvaine and Ross suggest that this organic binder, along with the surface smoothing, serves to stabilize an otherwise mobile surface. Clearly, any activities which destroy the biogeological relationships of apparently stabilized surfaces should be monitored for increased erosion effects and consequent bottom weakening, especially in areas where metastable slopes are indicated.

2. Meteorology and Physical Oceanography

Sections III.A.2 and III.A.3 describe the meteorological and physical oceanographic characteristics found in the North Atlantic. Average values of the climatological variables (see Sections III.A.2 and III.A.3) of the region do not pose a significant threat to oil and gas development. The concern in terms of meteorological and oceanographic conditions are events of an extreme nature, such as high speed winds with their associated high waves, tropical storms (cyclones), extratropical storms (northeasters), unusually low winter temperatures, reduction of visibility to less than 2 nautical miles, and incidence of icebergs and superstructure icing (ice accretion). These and various other factors will be discussed individually.

Storms and Associated Winds and Waves

Extreme wind speeds in the proposed Sale No. 52 area are likely to occur during the passage of either tropical or extratropical storms. The highest incidence of tropical storms occurs during late summer and autumn. Wind speeds as high as 100 knots (kt) and wave heights in excess of 40 ft may accompany these storms. According to Godshall *et al*, 1980, wave heights of 60 ft (18m) and 73 ft (22 m) with 10- and 100-year return periods, respectively, can be expected (see Section III.A, Surface Waves). When such conditions threaten, the normal procedures would call for operators to shut wells in with strom chokes and to evacuate platforms. Extra tropical storms generally occur between the months of October and April. These storms may be severe in terms of precipitation and winds and are also responsible for generating unusually high waves.

It should be noted that production platforms expected within the proposed Sale No. 52 area are being designed to withstand normal and extreme North Sea wind and wave conditions. These conditions are considered more severe than those encountered in the North Atlantic region (see Section IV.A.1).

Normal Surface Wave Conditions

Wave height is important in terms of oil spill cleanup and containment. It is generally recognized that the present upper limit of oil spill clean-up technology is in seas with waves heights somewhere between eight and ten feet (U.S. Coast Guard, 1980). High waves could increase the risk of vessel/vessel and vessel/platform collisions.

The highest waves are observed during the winter months: December, January, and February. During January, waves heights equal to or greater than 6 feet occur approximately 35% of the time; waves greater than 10 feet occur approximately 22% of the time; wave heights greater than 20 feet occur approximately 2.5% of the time (Godshall et. al., 1980). At other times of the year, the sea is normally less rough except in case of extreme events, already mentioned above, that are accompanied by exceptionally high winds.

Freezing Temperatures, Reduced Visibility, and Ice Accretion

Winter temperatures and wind chill factors, although not as severe as those encountered in the Alaska and North Sea operating areas, may cause some discomfort to rig personnel. These problems should be alleviated by the use of proper clothing. These factors, however, should pose little or no problem to the operation of equipment.

Ice accretion could present a problem during the winter months. The safe operation of vessels as well as moving parts of rigs and platforms could be adversely affected by heavy ice accretion; under these conditions, the stability of vessels would be jeopardized. However, the hazardous effect of ice accretion can be minimized by including provisions for the installation of heating coils and tapes, and expandable boots in design specifications. Icebergs are so rare as to be of no concern in the proposed Sale area.

Reduced visibility in the area has the potential for provoking an increase in collisions between vessels (fishing and others) and offshore structures. Percent frequency of restricted visibility (less than 0.5 nautical miles) is highest during May, June, and July: 11.6%, 12.8% and 11.0% respectively. Low visibilities could limit the use of helicopters and delay supply boats, but should not interfere with day-to-day drilling or production activities.

Shelf and Slope Current Systems and Associated Sediment Transport and Deposition

Bottom current systems play a distinct role in the transport and ultimate deposition of sedimentary material. In the proposed Sale No. 52 area the bottom current regime has been responsible for the formation of sand wave fields on the shelf. The impact of these bedforms and the associated effects of scour on drilling structures is discussed in Section IV.B.1. The bottom current systems also will determine the fate of drilling effluents in terms of transport and deposition. Associated impacts on water quality are discussed in Sections IV.C.3,4,6,7,8, and 9. Following is a discussion of sediment transport and deposition within the various zones of the proposed Sale area.

Sediment Transport Within the Shelf Zone
(water depths less than 200 m)

Frequent bottom sediment motion and transport can be expected within certain portions of the shelf zone (water depths less than 200 m) of the proposed Sale area.

Within the 60m contour, where the combined forces of bottom currents and tidal forces produce high bottom current speeds, sediment is almost constantly

in motion. EG&G Environmental Consultants (1979a) report a mean bottom current speed at 35m water depth during the period 23 April to 15 August, 1978 of 56.4 cm/sec. The theoretical sediment threshold velocity required to transport fine sand is 25 cm/sec. Near-surface tidal currents near the crest of the bank are typically 75 cm/s.

The flanks of sand waves found predominantly within the 60m contour are evidence of strong bottom current activity. The sharp asymmetry of these bedforms suggests probable migration (Aaron and others, 1980). Outside the 60m contour, where tidal forces are less pronounced, bottom current speeds decrease dramatically. Aaron and others (1980) report bottom current speeds ranging from 10 to 30 cm/sec in water depths of 85m on Georges Bank. Sediment transport can be expected to vary from area to area outside the 60m contour (see Section IV.B.1).

The bottom current velocities on the Georges Bank Shelf apparently decrease with increasing water depth. Bottom current measurements at a water depth of 200m (the shelf-slope break) indicated mean speeds of 16.9 cm/sec during the period 29 January to 30 April, 1979 (EG&G, 1979b). Although bottom current speeds of 29 cm/sec or slightly greater were reported during the winter months (EG&G, 1979b), current velocities necessary for the transport of the very fine-grained material found on the outer shelf are significantly greater than those required for the coarser material found on shallower portions of the Bank. This is due to the high cohesiveness of fine-grained sedimentary material (see Section IV.B.1). Nonetheless some transport of sediment can be expected, particularly during the winter months. Bothner et. al. (in press) report a net current flow from northeast to southwest on the outer half of the Georges Bank Shelf, indicating a probable direction of sediment transport.

In summary, the greatest amount of sediment transport on the Georges Bank Shelf occurs within the 60m contour. Only 7 tracts lie within this zone. Bottom currents decrease with increasing water depth, as a result of the decreasing influence of the tidal component. Nonetheless, some transport of sediment can be expected on the mid and outer portions of the shelf area, particularly during the winter months when bottom currents are more pronounced. There is a net bottom current (and possibly sediment) flow from northeast to southwest on the outer half of the shelf zone.

Sediment Transport Within the Slope and Rise Zones

The majority of tracts (364) selected for study for proposed Sale No. 52 lie in water depths greater than 200 m. Approximately 317 tracts lie in water depths between 200 m and 2000 m (slope), and 49 lie in water greater than 2000m (rise).

The only area of probable sediment transport on the slope appears to be within the submarine canyons, where high current speeds and ripple marks

have been reported (see Section IV.B.1). No evidence of sediment transport within the intercanyon areas has been reported. As noted in Section IV.B.1, high current speeds are necessary to transport the very fine-grained cohesive sediments found within these areas.

The current systems of the Continental Rise are not completely understood at the present time. It is doubtful, however, that deep ocean current systems are capable of transporting significant amounts of sediment, although the boundary layers of the various currents, with their opposing net directions of flow could affect the drilling rigs and platforms. The degree and kind of impact of these layers, however, is unknown at the present time.

In summary, the only areas of active sediment transport within the slope and rise zones of Georges Bank appears to be the submarine canyons. The ultimate fate of the sediments within the canyons is unknown at the present time.

Sediment Deposition Within the Proposed Sale Area

The only zone of active sediment deposition relative to the proposed Sale area appears to be the area of fine-grained sediment situated south of Martha's Vineyard (the "mud patch"). It lies within approximate water depths of 60m and 150m. Twichell, McClennen, and Butman (1980) and Bothner et. al. (in press) both provide evidence that this area is a present-day sink for fine-grained sedimentary material. Twichell, McClennen, and Butman (1980) surveyed the area by means of high-resolution seismic-reflection and side-scan sonar techniques to map its morphology and structure and a near-bottom instrument system contributed to understanding present activity of the deposit. Seismic-reflection profiles suggest that the deposit, which is as much as 14m thick, accumulated during the last transgression of the sea. The deposit apparently rests on a seismic reflector geomorphically similar to and continuous with the Holocene transgressive sand sheet still exposed on the shelf to the west.

Dating of the relict, underlying surface indicates that a large part of the fine-grained deposit has accumulated during the past 9000 years, suggesting that present hydraulic conditions and sedimentary processes have contributed to its formation. The deposit is at the boundary between two contrasting hydraulic regimes. To the east, on Georges Bank, the current system, as previously noted, is quite pronounced. To the west, on the Long Island Shelf, the current systems are weak. The "mud patch" is a transition area between these two regimes.

Twichell, McClennen and Butman (1980) note that southwestward migrating megaripples observed on the sonographs in the eastern part of the deposit are evidence that sediment is still actively accumulating in this area. The authors conclude that the probable sources of the deposited material

appears to be Nantucket Shoals and Georges Bank. The eroded fine-grained material from these two areas appears to have been transported westward by the mean drift to the southern New England Shelf, where a comparatively tranquil environment permits deposition of the fine material.

Bothner et. al. (in press) provide additional evidence that the "mud patch" is an active site of deposition and possibly a sink for fine grained pollutants from drilling discharges. They determined ^{14}C ages of the various sedimentary layers present within the area, took ^{210}Pb inventories and observed trace-metal profiles. Bothner et. al. (in press) conclude that the high accumulation rates, ^{210}Pb inventories, and trace-metal profiles imply that the area is a modern sink for fine-grained sediments and for pollutants associated with particulate matter in the water column. This area appears to be the only site of present-day natural deposition on the Continental Shelf off the northeastern United States, exclusive of the Gulf of Maine. The apparent source of the material is Nantucket Shoals and Georges Bank, due to the net current flow from northeast to southwest.

Although Twichell, McClennen, and Butman (1980) have suggested that some material may be removed from the "mud patch" and redeposited on the Long Island Shelf, the sediment input to the deposit appears to exceed the losses. Thus, drill muds and cuttings from oil and gas activities on the Georges Bank Shelf could ultimately be deposited in this area. The fate of drilling effluents discharged on the slope and rise tracts is uncertain at this time. It seems probable that some discharges will find their way into the submarine canyons where some degree of dispersion will take place.

C. Environmental Impacts of the Alternatives

1. Impacts on Air Quality

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Minimal and localized impacts on offshore air quality would occur from oil spills, oil or gas blowouts, pipeline breaks, tankers and supply vessels and from the normal exhaust of platform generators. The projected 10 large oil spills of 1000 barrels or greater and the smaller chronic discharges related to the proposed Sale operations would release hydrocarbons and other pollutants such as oxides of sulfur and nitrogen into the atmosphere through evaporation and combustion.

Natural gas blowouts or pipeline leaks would cause methane, ethane, propane, hydrogen sulfide, and other toxic gases to enter the atmosphere.

Offshore drilling facilities would also produce air emissions. However, all but accidental emissions from offshore oil and gas facilities are subject to Department of the Interior regulatory control (30 CFR 250) in order to ensure that they remain within acceptable limits, as determined on a case-by-case basis, and thereby should not significantly affect onshore air quality.

Offshore emissions would be generated at least 86 miles from shore, the distance of the nearest tract, and due to the prevailing westerly winds, would diffuse rapidly in the offshore air mass. Thus, emissions from offshore facilities located on the OCS would cause only minimal, temporary and therefore insignificant impacts on offshore air quality and virtually none on onshore air quality.

Onshore sale-related facilities would produce emissions that would impact local air quality. Major emissions increases would most likely be due to energy-related production facilities, particularly the gas processing plant, rather than to secondary industrial/economic development.

Major air emissions from the proposed gas processing plant in Bristol County would be hydrogen sulfide and sulfur oxides, the amount depending on the sulfur content of the gas discovered, and also hydrocarbons. Lesser amounts of particulates, carbon monoxide, and nitrogen oxides would be emitted. The magitude of air emissions will depend on the volume of gas processed, the composition of the raw gas, the plant design and the pollution control equipment installed. The actual quantity of sulfur dioxide emissions would depend on whether or not the plant contained additional conversion units which reconvert sulfur dioxide wastes to elemental sulfur or use only Claus Converters. In the first case there is a sulfur recovery rate of up to 99.9 percent, with about 4 pounds of sulfur dioxide emissions per ton of sulfur processed. The use of Clause Converters can yield 124-348 pounds of sulfur dioxide emissions per ton of sulfur processed, with a sulfur recovery rate of 92 to 97 percent (NERBC, 1976).

National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, one of the seven air pollutants under EPA regulation, have been met throughout the Massachusetts - Rhode Island region and are not a significant air quality problem. The major air pollution problems in the northeast are due to ozone (Ox) (which results from interactions of hydrocarbons, oxides of nitrogen, and sunlight), and, to a lesser extent, to carbon monoxide (CO). The entire region under concern is presently non-attainment (NAAQS are not being met) for ozone, and many areas within the region are non-attainment for CO.

The magnitude of impact on ambient air quality will be determined largely by the ambient air conditions, even though federal, state and local emissions standards would be met. (NERBC, 1976). In order to prevent significant degradation of local ambient air quality, industrial offsets may be required before plant siting could take place.

Air emissions at the Davisville and proposed Staten Island support bases, which are assumed to service offshore sale-related operations, would be generated by the servicing equipment and storage facilities. Also, emissions at the helciopter base on Hyannis would also impact local air quality there. However, as these are not major industrial facilities, impacts on air quality would not be significant.

Conclusion: Offshore air pollution will be minimal, temporary, and therefore insignificant. Only small amounts of hydrocarbons and other gases are expected to enter the offshore atmosphere, and these are expected to be rapidly dissipated across the Atlantic by the prevailing westerly winds.

Onshore impacts on air quality would be due primarily to the gas processing plant. Industrial offsets may be required before specific plant siting can take place.

CUMULATIVE IMPACTS

Discharges of oil during operations related to Sale No. 42 and proposed Sale No. 52 operations would release hydrocarbons and other pollutants into the atmosphere through evaporation. Natural gas blowouts and pipeline leaks could also occur, whereby gases would enter the atmosphere. In addition, offshore drilling facilities related to both sales would produce air emissions, although these are subject to Department of the Interior regulatory control.

Offshore emissions related to Sale No. 42, would be generated mainly on the Continental Shelf, whereas those related to proposed Sale No. 52 would be released primarily on the Slope. However, due to the prevailing westerly wind, cumulative impacts could result over the region of the Slope. Effects would be temporary, as pollutants would be rapidly diffused in the offshore air mass at a distance of at least 86 miles from shore, and dissipated by the prevailing westerly winds.

Cumulative impacts onshore from OCS-related facilities would occur primarily at the Davisville supply base which would need to expand its operations to service operations related to Proposed sale in addition to those from Sale No. 42.

Exact quantities of pollutants cannot be predicted. However, due to the low resource estimates for the Sale No. 42 area, cumulative impacts both offshore and onshore would not be significantly greater than those resulting from proposed Sale No. 52 itself.

Cumulative impacts on regional air quality could occur in southeastern Massachusetts from the combined emissions of the proposed gas processing plant in Bristol County and emissions of several non-OCS-related industrial facilities planned for that region (See Section IV.C.11 Conflicts With Land Use Plans and Policies). Before siting of the gas processing plant could take place, industrial offsets may be required to prevent significant degradation of local ambient air quality.

Conclusion: Cumulative offshore air quality impacts from Sale No. 42 and proposed Sale No. 52 would occur primarily on the Continental Shelf where operations related to both sales would take place. These impacts, however, would be minimal, temporary, and therefore insignificant.

Cumulative onshore impacts could occur on the regional air quality of southeastern Massachusetts due to the combined emissions from the proposed gas processing plant and non-OCS-related industrial facilities planned for that region. Industrial offsets may be necessary before plant siting can take place. Cumulative onshore impacts would also occur at the expanded Davisville supply base.

ALTERNATIVE 2: DELAY THE SALE

Delay of the proposed Sale would not eliminate impacts on air quality that have been decribed in this section. Impacts would merely be delayed for whatever period of time was involved. Delay of the proposed Sale could possibly mean that the air quality impacts would occur at a later time when population, economic, and industrial growth has increased ambient air pollution problems in the region. If such were to occur, the combined impacts could be greater in magnitude than during the currently scheduled time (October, 1982).

Conclusion: Delay of the proposed Sale would delay the onset of sale-related impacts on air quality. However, their magnitude would not be reduced.

ALTERNATIVe 3: CANCEL THE SALE

Cancellation of the proposed Sale would eliminate the air quality impacts discussed for the proposed action. However, since operations related to Sale No. 42 would still take place, all impacts on air quality due to exploration and development in the North Atlantic would not be eliminated.

Conclusion: Cancellation of the proposed Sale would eliminate sale-related air quality impacts, but not all impacts of OCS development in the North Atlantic.

ALTERNATIVE 4, 6, and 8: DELETE $(TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS; DELETE 33 TRACTS IN CANYON HEAD VICINITY; DELETE 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Deletion of tracts under these three alternatives would not substantially reduce impacts on offshore or onshore air quality resulting from proposed Sale No. 52 operations as only 6 to 18 percent of the orginally proposed Sale area would be eliminated. Impacts on air quality that have been described under Alternative 1 could still be expected for the proposed Sale region.

Conclusion: Deletion of tracts under Alternatives 4, 6, and 8 would not substantially reduce offshore and onshore air quality impacts from that expected under Alternative 1.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts to protect fisheries and other biological resources constitutes a 36 percent reduction in the size of the proposed Sale area. If it is assumed that roughly 36 percent fewer wells would be drilled, this would be a substantial reduction. This could result in a substantial decrease in the amounts of pollutants entering the offshore atmosphere, and therefore a reduction in the extent of offshore air quality impacts.

As the distribution of resources estimated for the proposed Sale area is not now known, it is unknown whether the elimination of these tracts would result in a substantial reduction in the amounts of resources expected to be recovered and thereby reduce onshore facilities required and resulting impacts.

Conclusion: Deletion of 36 percent of the proposed sale area may result in a comparable and therefore substantial reduction in sale-related offshore air quality impacts from that expected under Alternative 1. Onshore air quality impacts could also be reduced, depending on the reduction in onshore facilities required for the resulting volume of resources discovered.

ALTERNATIVE 7: A GEORGES BANK MARINE SANCTUARY

The only restriction on oil and gas activities under this option that may affect air quality is that of piping oil within the designated area. If the probability of tanker spills in this area is thereby eliminated, impacts on air quality from hydrocarbon evaporation, which are already considered to be insignficant, would be eliminated also. Other air quality impacts would remain as described under Alternative 1.

2. Impacts on Water Quality

Offshore water quality could be affected by the following major sources of pollution: discharges of drilling muds and cuttings; discharges of formation waters; oil spills and chronic discharges of oil; discharges of domestic and sanitary wastes; discharges from routine vessel and tanker activity; installation of pipelines; gas blowouts and pipeline breaks. These sources are examined first individually, then later taken into account all together.

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Drilling Muds and Cuttings

The discharge of drilling muds and cuttings is regulated by the U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit requirements as discussed and cited in Sections IV.A.3. and Appendix I. Although the discharge of oil-based muds is prohibited, substantial quantities of conventionally-used muds can be discharged. The volume of drilling muds and cuttings expected to be discharged during operations related to proposed Sale No. 52 is given in Table IV.C.2-1. Over the life of the proposed Sale field the U.S. Geological Survey estimates a total of 11,601,962 barrels of drilling muds and 1,840,651 barrels of cuttings could be discharged.

In order to determine the fate and effects of discharged drilling materials in the marine environment, rig-monitoring studies have been conducted at drilling locations off California and Alaska, in the Gulf of Mexico, and in the Mid-Atlantic (see Ayers _et_. _al_., 1980; Ayers _et_. _al_., 1980a; Dames and Moore, 1978; Ecomar, Inc., 1978; Mariani _et_. _al_. 1980; Meek and Ray, 1980; Ray and Meek, 1980; Zingula, 1975; Zingula and Larson, 1977). These studies have monitored the dilution, dispersion, transport and impacts of drilling muds and cuttings as related to water quality, bottom sediments, and biota. They have demonstrated that, due primarily to the immediate settling of the bulk of the solids and rapid dispersion of the particles remaining in the upper plume, drilling discharges have a minimal effect on water quality (Ayers, 1980).

Rig-monitoring studies performed to date were reviewed during the symposium on Research on Environmental Fate and Effects of Drilling Fluids and Cuttings, January 21-24, 1980 in Lake Buena Vista, Florida, and have been summarized by Houghton _et_. _al_., of Dames and Moore (1981). These studies have demonstrated that effects on water quality and hydrography are minor, localized, and temporary. Dissolved oxygen, pH, salinity, and temperature are affected only in the immediate vicinity of the discharge - temperature and pH may become slightly elevated while oxygen and salinity may decrease. Measurements of these parameters at 40 meters from the point of discharge have shown them to be unchanged from background levels. Beyond the immediate area of discharge the parameters that are affected by drilling materials are levels of suspended solids and the degree of light transmittance. Transmittance is the only hydrographic variable found to be affected by these discharges (Ayers _et_. _al_., 1980; Ayers _et_. _al_., 1980a).

Table IV.C.2-1

Total Volume of Discharges

	Low Resource Estimate (.017 BBO)*			Mean Resource Estimate (1.73 BBO)*			High Resource Estimate (6.35 BBO)*		
	Barrels Per Well	Wells	Total Barrels	Barrels Per Well	(1.73 BBO)* Wells	Total Barrels	Barrels Per Well	Wells	Total Barrels
Drilling Muds									
Exploratory Wells	28,996	10	289,960	20,100	17	341,700	22,050	27	595,350
Delineation Wells	28,996	1	28,996	17,793	26	462,618	21,734	24	521,616
Development Wells	32,950	12	395,400	22,828	473	10,797,644	26,004	1,183	30,762,732
Drilling Cuttings									
Exploratory Wells	3,878	10	38,780	3,067	17	52,139	3,551	27	95,877
Delineation Wells	3,878	1	3,878	3,333	26	86,658	3,165	24	75,960
Development Wells	4,023	12	48,276	3,598	473	1,701,854	3,751	1,183	4,437,433

Pipelines (4,000-8,000 cu. yds. sediment per mile disturbed)

Low		Mean		High	
Miles	Sediments Disturbed (cu. yds)	Miles	Sediments Disturbed (cu. yds)	Miles	Sediments Disturbed (cu. yds)
-	--	400	1,600,000 3,200,000	400	1,600,000 3,200,000

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*Billion Barrels of Oil

Source: USGS, 1981

The bulk of discharged drilling materials (over 90 percent) falls out rapidly around the point of discharge. Depending on the rate of discharge and on local hydrographic conditions, the remaining suspended solids concentrations are usually reduced to .01 percent or less of the original value within 100 meters of the discharge and, due to continued settling and dispersion, normally reach background levels within 1000 meters down current. Generally, the transport time required for suspended solids to reach background levels is an increasing function of rate of discharge. (Ayers, 1980; Ayers et. al., 1980).

In one recent study (Ayers et. al., 1980), solids conentrations dropped 3 to 4 orders of magnitude within a distance of 100 meters. Other studies (Dames and Moore, 1978; Ecomar, 1978) found the discharges to be diluted 500:1 to 1000:1 within 3 meters of the discharge point, with an additional 100:1 dilution within 100 meters.

Monitoring for the C.O.S.T. well Atlantic G-1 in the Georges Bank area also showed rapid dilution of drilling discharges (ENDECO, 1976). Suspended solids ranged from 0.1 to 5.8 mg/l at a distance of 100 meters from the discharge point, and location of the upper plume down-current proved to be difficult (Houghton et. al., 1981).

Transmittance values reach background levels at a slightly greater distance than suspended solids. This is attributed to the presence of colloidal particles in the water column at levels insufficient to measurably contribute to the suspended solids content but still sufficient to cause detectable light scattering. In high rate 1000 bbl/hr tests, transmittance value were found to reach background levels at about 500 meters beyond the point where suspended solids did (Ayers, et. al., 1980; Ayers et. al., 1980a).

Trace metal dilution rates, as measured by suspended solids concentrations, have been shown to be similar to that of whole muds (Ecomar, 1978; Zingula, 1975). Increases in trace metal concentrations are usually limited to within 1000 meters of the discharge point. For the Georges Bank C.O.S.T. well G-1, background levels of barium and chromium were reached within 183 meters down current of the drillsite in the direction of major flow (ENDECO, 1976). However, in other areas trace metals have been shown to accumulate in sediments as far as 2 miles downstream from the discharge site (Ecomar, 1978; Dames and Moore, 1978; Mariani et. al., 1980).

Although the behavior of drilling discharges in the North Atlantic has not been extensively studied, limited inferences can be made from the studies conducted in other areas. The initial dispersion and deposition of drilling discharges in the proposed Sale area would probably occur as observed for other areas, whereby the bulk of the discharged materials (over 90 percent) immediately settles to the bottom and the remaining upper plume disperses within a short distance and period of time, depending on the rate of discharge (Ayers, Personal Communication, 1981).

Two factors in particular - currents (including tidal currents) and water depth - would be significant in determining dispersion of the materials from the point of discharge. Because of the relatively small volume of this component compared to the large volume of receiving water in a proposed Sale area of 4,860 square miles, a significant impact should not happen.

Rapid initial dilution rates of 500:1 to 1000:1 could be expected within a few meters downstream of the point of discharge, with dilutions of 10,000:1 occurring within 100 to 200 meters. Within this distance concentrations of whole muds (containing 250,000 mg/1 solids) could be diluted to about 100 mg/1 (with 25 mg/1 suspended particulates). With a 30 cm/sec surface current on Georges Bank, this dilution would be reached in about 6 minutes. Dilution would continue with increasing distance, and settling of finer and finer particles from the upper plume would occur (Houghton et. al. 1981).

Soluble components would undergo the same general dispersion characteristics as the fine particulate fraction, and become well mixed in the water column within a few hours of discharge. Dilution ratios for soluble components have been estimated to be two orders of magnitude lower than those of the solids components (Ayers et. al., 1980). However, within a few kilometers they too would become diluted to undetectable levels and be ultimately lost in the large volume of receiving water (Houghton et al., 1981).

Tremendous dilution of particulate trace metals contained in the discharges also occurs as muds are dispersed. In a 1000 bbl/hr discharge test, barium, chromium and aluminum concentrations all reached background levels within 1100 meters of the discharge point (Ayers et. al., 1980). Caluculations performed at Dames and Moore (Houghton et. al., 1981) for Sale No. 42-related discharge volumes indicate concentrations of barium and chromium on Georges Bank would be well below natural background concentrations found in sea water (0.050 and 0.001 mg/1, respectively). Zinc and all other trace metals would be an order of magnitude lower than chromium.

According to the assumptions given above, there would be no significant impact of Sale No. 52-related drilling discharges on the water quality of Georges Bank. Even on the crest of the Bank, within the 60-meter isobath, impacts on water quality would be insignificant. As there are only 7 Sale-related tracts within the area, the amount of drilling materials discharged - assuming that 10-30,000 bbl of drilling muds and cuttings and 3-6000 bbl solids control materials are discharged over the life of a well (Ayers, 1981) - would be very small in relation to the large volume of receiving water.

Within the 60-meter isobath turbulence would tend to maintain smaller clay particles in suspension long enough for transport off the Bank. Larger flocculated materials that settle would ultimately be resuspended and transported in the nepheloid layer by near-bottom processes. Also, it has been hypothesized that the gyre system of ocean currents over the Bank would maintain drilling materials on top of the Bank for long periods of time before they would eventually be transported off - most likely exiting from the northern flank of the Bank and deposited in the Gulf of Maine (Houghton et. al., 1981). However, even if minute particles remain suspended in the water column, the turbulence here would also promote wide dispersion of these materials in the large volume of receiving water, whereby concentrations of initially-discharged and resuspended

materials in the water column would be extremely small, if at all detectable, and therefore insignificant.

In deeper waters the initial dispersion of discharged materials and associated trace metals would also be enhanced by increased settling distance afforded by the greater water depth. Deeper waters would then increase the area of initial deposition of drilling materials. Dispersion of discharged solids on the southern flank of Georges Bank will vary, depending on the hydrographic conditions at the time, but generally, from shallow water (30-60 meters) to the Shelf break (200 meters) the area of initial deposition of cuttings would increase by a factor of 7 to 10, largely as a result of the increased trajectory provided by the greater water depth (Houghton et. al., 1981). On the Slope, areas of deposition would increase to an even greater degree.

Bottom currents within the Georges Bank region apparently decrease with increasing water depth. In areas shallower than 100 meters deposited drilling muds would remain for only a short period of time, as confirmed by observations for the C.O.S.T. well G-1 on Georges Bank (ENDECO, 1976) that found drilling muds and associated trace metals to readily disperse. However in areas deeper than 100 meters, where currents are weaker, deposited materials would tend to remain longer (Houghton et. al. 1981).

Limited current data of Wunsch and Hendry (1972) have shown the Slope and Rise to be a quiescent environment suitable for the permanent deposition of sediments (Houghton et. al., 1981). Drilling discharges on Slope blocks, then, would not only undergo greater initial dispersion while settling than observed in Shelf areas (due to farther transport while settling through the deeper water column), but, once deposited, would not readily be resuspended and transported due to the presence of weaker bottom currents.

One feature that may affect dispersion of drilling materials in deeper areas is the "cold band" - a band of water along the Shelf between the seasonal thermocline present in the spring and summer and the Shelf/Slope front, extending from Georges Bank to Cape Hatteras. Mixing between waters of the "cold band" and adjacent waters, and thereby the accompanying transfer of materials, is generally reduced. However, this is a large-scale feature involving a large volume of water while the initial dispersion of drilling materials is a localized event. Materials discharged within the "cold band" would therefore behave as observed in other areas. Transport of resuspended materials between waters of the "cold band" and adjacent water masses, however, would probably be reduced.

The position of the Shelf/Slope front (the boundary between Shelf and Slope waters) may influence the dispersion and resuspension of drilling materials. The front generally moves from the region of the 100-meter isobath out to the Shelf break and beyond onto the upper Slope. Due to temperature and salinity gradients between the two water masses (Shelf and Slope), it is a zone of enhanced turbulence. This turbulence could promote dispersion of discharges within the water column and resuspension of bottom materials. However, the front is not a traveling water mass that would entrain materials upon discharge and transport them to other regions.

Gulf Stream eddies enter the Slope region several times during the course of the year. Theoretically, depending on the location of the leading edge of the eddy, some materials could be resuspended and transported either up onto the Shelf or out to the Gulf Stream and deeper ocean waters. In terms of initial settling, though, eddies also are very large-scaled phenomena while the dispersion of drilling discharges is a relatively small, localized event. Drilling discharges would therefore disperse as observed in other areas.

How factors governing resuspension of settled materials would affect subsequent transport and dispersion is not well known. However, resuspension and transport would depend on local hydrographic and meteorologic conditions (e.g. current regime, tidal movement, storms, sediments, etc.) which, in the proposed Sale No. 52 region, would probably play an important role in determining the ultimate deposition of drilling solids and related trace metals. The Georges Bank Monitoring Program funded by the Department of the Interior is designed to determine, among other processes, the behavior and long-term fate and effects of drilling materials.

Regarding muds and cuttings, then, although the total volume of drilling materials discharged as a result of the proposed Sale is large, particularly on the Slope where most of the blocks are located, impacts on water quality will not be significant. This is because: discharges would be spaced over a period of 46 years (the assumed time span of operations-exploratory developmental, and production); the discharge points would be located far apart spaced over an area of approximately 4,860 square miles; and, most important, over 90 percent of the discharged material would immediately settle to the bottom (see Sections IV.C.3 and IV.C.4, Impacts on Plankton and Benthos), and the relatively small volume of particles remaining in the upper plume disperse to background levels in the large volume of receiving water within a short distance and period of time. Oceanographic features such as the "cold band" and Gulf Stream eddies should not have a significant effect on the initial dispersion of drilling materials in the water column since, similarly, discharges would be a small volume of material compared to the large volume of receiving water.

Formation Waters

Characteristics of formation waters and EPA discharge limitations are discussed in Section IV.A.3, Impact Producing Factors: Water Pollutants. Over the life of the proposed Sale No. 52 field the volume of formation waters discharged from platforms would average about one barrel of formation water for every barrel of oil produced, thereby totaling 1.73 billion barrels.

Discharged formation waters would undergo dispersion similar to that described for fine particulate and liquid drilling discharges whereby they would be rapidly diluted and ultimately lost in the large volume of receiving water. Also, because the total volume of formation waters would be discharged over

a long period of time - an assumed production period of 30 years - and because the discharge points would be spaced over a large area, the impact on water quality would not be significant. Any effects would be temporary and localized around platforms.

The hydrocarbon content of discharged formation waters would be within EPA's prescribed limits. Based on EPA's maximum allowable monthly average concentration of 48 mg/l, over the life of the field each production platform could discharge a total of 4,152 barrels of oil in formation waters. On a yearly basis this amount would not be significant, as only small, localized incremental increases of hydrocarbons would occur at any given time. Hydrocarbons discharged in formation waters are present as small droplets or in dissolved form and upon discharge rapidly disperse in the large volume of receiving water whereby they evaporate or degrade.

Where production platforms are in operation over a long period of time, trace metals which are insoluble in sea water could accumulate in the surrounding sediments. However, due to the extremely low concentrations that are present in formation waters - in the parts per billion (ppb) range - such accumulations would be very small. Soluble trace metals, which are also present in extremely small quantities, would become diluted in the water column and be transported away. Trace metals present in discharged formation waters, then, would not cause significant impacts on ambient water quality.

Formation waters have a relatively high density and low oxygen concentration compared to sea water. Due to these characteristics, if large volumes are discharged near the bottom in deeper areas where bottom turbulence is not strong, high-density flows of low-oxygen water that may affect epibenthic and demersal biota could result. If formation waters are discharged near the surface, however, they would rapidly disperse in the water column and thereby have no substantial effect on ambient water quality.

Oil Spills

Large acute oil spills and chronic low-level discharges of oil could occur from drilling platforms, gathering lines from subsea complexes, exploration vessels, survey ships, tanker operations, and other marine support vessel activity related to the proposed Sale. During recovery of sale-related resources OSTAM predicts that 10 major oil spills of over 1000 barrels could occur over the life of the field.

Both large acute spills and smaller chronic discharges of oil will have impacts on water quality. These impacts would depend on the actual behavior and fate of oil in the water column (eg: movement of oil; rate and nature of weathering), which, in turn, would depend on the hydrographic and meteorologic features present at the time. Oil remaining in the water

column after evaporation and dissolution of the lighter molecular weight fractions could undergo any of several weathering processes, including dispersion, emulsification, tarball formation, and photo-oxidation. Photo-oxidation could result in the formation of toxic products in the water column. Eventually, weathered oil would settle to the bottom where it would become incorporated into the sediments to undergo further chemical and biological oxidation. The effect on ambient water quality would be temporary in the case of large acute spills but of longer duration (although not permanent) in the case of chronic discharges.

On the crest of Georges Bank, within the 60-meter isobath, turbulent high-energy hydrographic conditions would tend to maximize the break-up and dispersion of spilled oil and thereby its evaporation and weathering. However, weathered oil here could be circulated around the Bank before complete degradation occurs or before it is transported off the Bank at one of the potential exit areas. Residence times on the Bank are not well known, but a drogue deployed by EG&G was observed to remain on the Bank for about 3 months (EG&G, 1979) The likelihood of any significant impact on water quality in this region due to proposed Sale No. 52, however, is small since only 7 sale-related blocks are located within the 60-meter isobath.

OSTAM has predicted the probability that a spill which occurs outside the 60-meter isobath zone would strike and thus impact the crest of the Bank. The model indicates there is a significant probability - up to greater than 99.5 percent - that <u>if</u> a spill occurs on the shelf near the crest, the crest would be impacted. The probability of impact depends on the location of the spill, and diminishes with distance from the crest. Thus, the probability that a spill which occurs out in the 100 to 200 meter zone would impact the crest of the Bank is reduced to 10-34 percent 30 days after the spill occurred.

A spill occurring on the Slope could also eventually strike the crest of the Bank, but the probability is not significant - at 30 days, there is no more than a 12 percent probability that it would impact the crest.

There is a substantially lower probability that the Gulf Stream would be impacted by an oil spill which occurred on the Slope or Rise - no more than a 25 percent probability at 30 days, depending on the exact location of the spill in relation to the Gulf Stream.

Routine petroleum discharges associated with deck drainage, ballast water, etc. are subject to EPA NPDES permit requirements as cited in Section IV.A.3 - Impact Producing Factors, Water Pollutants. But due to the subjective nature of the "no visible oil or sheen" standard for deck drainage, oil in these chronic discharges could cause temporary, localized impacts on water quality in the vicinity of drilling rigs. These impacts would not be significant because for the entire proposed Sale area no more than 22 exploratory wells are expected to be drilled during any single year. (Deck draingage is primarily associated with drilling rigs, not production platforms) and it is unlikely that all rigs would be concentrated within one particular region. Also, the same forces that promote the dispersion and degradation of large acute spills would also act upon chronic discharges of oil in deck drainage.

Domestic and Sanitary Wastes

Domestic and sanitary wastes will be discharged from drilling rigs and platforms. On the average, approximately 6,000 gallons per day are discharged at an exploratory well site and 5,000 gallons per day at a development site (FEIS for OCS Sale No. 49). The discharges would be subject to EPA NPDES permit regulations as cited in Section IV.A.3. Impact Producing Factors: Water Pollutants.

Plume models (Massachusetts Institute of Technology, 1973; Mobil Plume Model, 1976) indicate that sanitary waste effluents are rapidly dispersed and diluted in the water column. Within 100 meters downstream, an instantaneous release of 1,000 gallons of wastewater is diluted by 1/1,000 (Mobil Plume Model, 1976).

Impacts on water quality from the discharge of treated sanitary wastes would consist primarily of an increase in suspended solids (organic material) and accompanying BOD, and thereby a decrease in oxygen levels in the water column. In addition, low levels of discharged chlorine could eventually form toxic compounds. Impacts from these discharges, however, would be localized near the point of discharge, and because pollutants would be diluted and dispersed in the large volume of receiving water, would be insignificant.

Pipeline Installation

Pipeline installation will resuspend sediments on both the Slope and Shelf and thereby cause temporary increases in water column turbidity. The magnitude and extent of any increase in turbidity would depend on hydrographic factors operating at the time of installation, on the duration of activity, and on the type and grain size of the bottom materials. Generally, though, the sandy substrate found on the Shelf would not remain in suspension as long as would the finer materials of the Slope. Suspended sediments of both lhe Georges Bank region and the Slope would be dispersed and transported in the prevailing current direction and eventually deposited as described for general sediment transport in Section IV.B.1. Geology. Overall impacts on water quality due to pipeline installation, then, would be temporary and, due to dispersion in the large volume of receiving water, insignificant.

Gas Blowouts and Gas Line Breaks

For the mean resource estimate about 400 miles of gas pipeline are assumed to be installed on the OCS (U.S. Geological Survey, 1981). Breaks or ruptures of gas pipelines could occur although the probability and frequency are unknown. Gas released into the water column would probably result in increased levels of light molecular weight hydrocarbons (C2 to C5) which would subsequently evaporate into the atmosphere. Areas of up to 25 square miles have been reported to be affected in this manner (Parker, 1974). However, concentrations would return to background levels

after the gas flow had been curtailed. The most significant effect of gas blowouts would be the localized disturbance of sediments, resulting in temporary resuspension into the water column. Impacts from pipeline accidents, however, are considered to be temporary and would not cause significant impacts on water quality.

Conclusion: Sale No. 52 would result in temporary and localized impacts on offshore water quality. Impacts discharged from drilling-related materials would not be significant. Discharged drilling muds and cuttings would cause temporary increases in suspended solids and trace metals in the immediate vicinity of drilling rigs. Discharged formation waters would cause localized, minor elevations in inorganic salts, trace metals and hydrocarbon levels around platforms. Oxygen levels near the point of formation water discharge could be slightly reduced. Oil spills and chronic discharges of oil would temporarily increase hydrocarbon levels in the water column. Oil could settle to the bottom to vecome incorporated into the sediments. Treated sewage from rigs and platforms would increase levels of suspended solids (organic matter), BOD, nutrients and chlorine in the immediate vicinity of the discharge. Temporary water column turbid9ty due to resuspension of sediments would be caused by pipeline installation.

CUMULATIVE IMPACTS

Operations related to proposed Sale No. 52 are assumed to include 17 exploration wells, 26 delineation wells, and 473 development wells over the life of the field. In addition, Sale No. 42-related operations are assumed to include 10 exploration, 5 delineation, and 78 development wells. OSTAM predicts one major oil spill greater than 1000 barrels to occur as a result of Sale No. 42, while 10 major spills are predicted duriing proposed Sale No. 52 operations. Operations from both sales would result in cumulative impacts on water quality due to oil spills and chronic discharges from drilling vessels, platforms, and transport vessels. Overall, cumulative impacts on water quality would consist mostly of those related to proposed Sale No. 52 due to the large size of the sale area.

Within the Georges Bank region cumulative impacts on water quality would be generated primarily on the Shelf. On the Slope any impacts from Sale No. 42 blocks would occur only if pollutants are transported from adjacent Shelf areas as there are no Sale No. 42 blocks on the Slope. Such impacts would not be significant.

Cumulative impacts from the discharge of drilling muds and cuttings would be the same as described for the proposed sale. Although the total volume of matierials discharged would be significantly greater with the addition of proposed Sale No. 52 operations (assuming Sale No. 42 drilling is under way at the time) impacts on water quality would still not be signi-

ficant due to the rapid nature of settling and dispersion, the large volume of receiving water, and the spacing of discharges over a large area. Water quality on Slope areas adjacent to Sale No. 42 blocks would probably not be affected, or, if so, effects would be negligible.

On the crest of Georges Bank within the 60-meter isobath, also, cumulative impacts on water quality would not be significant due to the small number of blocks for both Sales within that area (9 Sale No. 42 blocks and 7 proposed Sale No. 52 blocks).

Impacts from major oil spills associated with both sales could increase substantially with proposed Sale No. 52 development, as 10 additional spills over 1000 barrels are predicted to possibly occur during development of those resources.

OSTAM does not differentiate what portion of large spills related to OCS sales would result from tankering although oil from both Sale No. 42 and proposed Sale No. 52 would be tankered through the Mid-Atlantic Bight. The sales primarily responsible for probable large spills that could affect Mid-Atlantic water quality and thus produce cumulative impacts are proposed Sales No. 59 and Sale No. 52 (14 and 10 large spills over 1000 barrels, respectively). But as OCS development would replace a certain amount of oil tankered from elsewhere, spills from those sources would be reduced.

Within areas of the Shelf where drilling related to both sales would take place, chronic discharges of oil would also increase significantly with proposed Sale No. 52-related operations. Adjacent Slope areas could also be affected if hydrocarbons from Sale No. 42-related discharges are transported there. Effects on the Slope from Sale No. 42 operations, however, would not be significant.

Proposed Sale No. 52-related operations would also result in significant increases in the volume of discharged formation waters and other routine discharges such as sanitary wastes and deck drainage, all of which are limited by EPA NPDES permit requirements. Impacts on water quality, however, would not be significant, as discharges would be spaced over a large area and would rapidly disperse within the large volume of receiving water. To transport gas resources developed within the North Atlantic, one pipeline would be installed offshore to accomodate Sale No. 42 resources, whereas two would be needed for proposed Sale No. 52 transportation. Therefore cumulative impacts on water quality due to installation of the two additional pipelines can be expected. As discussed under the proposed action, however, impacts such as gas blowouts and resuspension of sediments during installation are minor and temporary in nature.

Conclusion: Although potential operations from proposed Sale No. 52 are far more extensive than those resulting from Sale No. 42, overall impacts on water quality would not be significant.

ALTERNATIVE 2: DELAY THE SALE

Delay of the proposed Sale would serve to delay those water quality impacts discusses for Alternative 1. Initial results from the on-going Interior-funded Georges Bank Monitoring Program and the Canyon Processes Study, as well as from the Exxon-sponsored Toms Canyon Monitoring Program, should provide information on the behavior, fate, and effects drilling materials on Georges Bank, on the Slope, and in several submarine canyons, appropriate mitigating measures could be developed prior to operations.

Conclusion: Delay of the proposed Sale would merely delay water quality impacts due to sale-related exploration and development.

ALTERNATVE 3: CANCEL THE SALE

Cancellation of the proposed Sale would eliminate water quality impacts expected to result from the proposed Sale. Since exploration and development is still scheduled for Sale No. 42 blocks, however, all impacts on water quality due to OCS drilling on Georges Bank would not be eliminated, but would be significantly reduced in magnitude. Impacts on Slope water quality, however, would be eliminated or reduced to minimal impacts from those few Sale No. 42 blocks located near the Shelf-Slope break. Given the right set of hydrographic circumstances, it is possible that materials discharged from well sites near the Shelf/Slope break could be transported onto the Slope. However, most impacts on water quality would be confined to those Shelf areas drilled as a consequence of Sale No. 42. In addition, imported oil and domestic oil from other regions would continue to be tankered through the North and Mid-Atlantic, posing a much more significant threat to water quality.

Conclusion: Cancellation of the proposed sale would eliminate sale-related water quality impacts.

ALTERNATIVE 4: DELETE 49 TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

Deletion of 49 tracts in waters deeper than 2000 meters constitutes only a 9 percent reduction in the proposed Sale area. Such a small reduction would not substantially reduce impacts on water quality as most are already not considered to be significant. Therefore, nearly the same magnitude of impact described under Alternative 1 could be expected for a proposed sale under this alternative.

Conclusion: Deletion of 9 percent of the proposed Sale area would not substantially reduce the magnitude of impact on water quality as described under Alternative 1.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts, or 36 percent of the proposed Sale area to protect fisheries and other biological resources would eliminate all tracts within the 200 meter isobath and tracts in the heads of canyons. Accordingly, impacts on water quality for the region within the 200-meter isobath, and in canyon head areas, as described under Alternative 1, would be eliminated. As a substantial reduction in the level of operations is expected to result from a sale under this alternative, a substantial decrease in the extent of impacts on water quality could also result.

Conclusion: The deletion of tracts to protect fisheries and other biological resources would eliminate impacts on water quality within the 200-meter isobath, as described under Alternative 1. This could constitute a substantial reduction in the total extent of water quality impacts described for Alternative 1.

ALTERNATIVE 6: DELETE 33 TRACTS IN CANYON HEADS' VICINITY

Deletion of 33 tracts at the heads of canyons would eliminate the amount of drilling-related discharges that could possibly be transported to deeper canyon areas. It is also possible that water quality at canyon heads could be affected by materials discharged from adjacent tracts through mechanisms of resuspension and transport, although if this occurred resuspended solids

would primarily occupy the nephloid layer of the water column. Also, discharges in deeper canyon tracts would still impact water quality there. Overall, the total reduction on water quality impacts within the proposed Sale area would not be substantial as this would be only a 6 percent reduction of impacts that are already considered to be insignificant under the original proposal.

Conclusion: Deletion of tracts at the heads of canyons would constitute only a negligible reduction in the overall impacts on water quality expected under Alternative 1, as impacts of drilling muds and cuttings on water quality are already considered to be insignificant under the original proposal. Deep canyon areas could still be impacted from discharges on those tracts and from discharges transported from tracts adjacent to canyons.

ALTERNATIVE 7: A GEORGES BANK MARINE SANCTUARY

1. If the barging of drilling muds and cuttings from canyon head tracts is required, impacts normally stemming from these discharges would be eliminated within those tracts. Also, the amount of materials that could be transported to deeper canyon areas would be reduced. However, water quality in canyons head tracts could still be affected by materials resuspended and transported from adjacent tracts, although if this occurred resuspended would occupy primarily the nephloid layer of the water column. Although most of the impact on water quality at canyon heads would be eliminated, water quality of deeper canyon areas would still be affected by drilling discharges. Overall, the total reduction on water quality impacts within a marine sanctuary from eliminating drilling discharges on 33 canyon head tracts would not be substantial, as drilling-related impacts on water quality under the original proposal are already considered to be insignificant.

2. If drilling discharges are controlled as required under EPA NPDES Permits for Sale No. 42 blocks dilution of discharged suspended solids would be enhanced and concentrations in the water column at any given time would be reduced from that expected under normal discharge practices. Background levels of these materials would be reached within a shorter distance than the usual 1000 to 1500 meters. However, it is doubtful if this would substantially reduce impacts on water quality because even under normal practices over 90 percent of the solids immediately settles to the bottom upon discharge, and the remainder is quickly dispersed in the large volume of receiving water.

Also, with a reduced discharge rate (30 bbl/hr) and predilution (10:1) the nature of the discharge would change from one that is intermittent (under normal practices) to one that is nearly continuous. The settling rate of discharged solids would also be increased, as this is also a function of plume density as well as particle density. Thus, even though solids concentrations at any given time during discharge would be reduced, concen-

trations still higher than normal background levels would be maintained in the water column for a significantly longer period of time, and over a larger area, posing an even worse situation.

A reduced discharge rate and predilution could also result in a wider dispersal of solids settling to the bottom. This would result in a reduced depth of burial for benthos in the vicinity of the discharge, but at the same time the zone of impact from settled materials would be increased, depending on the hydrographic regime at the time.

3. Pipelining of oil to a moored buoy outside the sanctuary would result in the elimination of tanker spills and related water quality degradation within that area, although pipeline spills or leakages could still occur. Outside the sanctuary area, the likelihood of tanker spills would probably remain as described under the original proposal, and impacts described under the original proposal could still be expected.

Additional pipeline construction within the sanctuary would expand the extent of related impacts, such as water column turbidity, from that expected under the original proposal. Such affects would be temporary and not result in significant impacts on water quality, as described under the original proposal.

ALTERNATIVE 8: DELETE 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Deletion of 94 tracts containing possible sediment slumps would be only an 18 percent reduction in the proposed Sale area. A proportional, and therefore not significant, reduction in the total extent of water quality impacts, which are already not considered to be significant, could therefore be expected. Also, water quality impacts on Georges Bank and other Shelf areas would not be reduced at all under this alternative.

Conclusion: This alternative would not result in a substantial reduction of impacts on water quality, most of which are already not considered to be significant.

3. Impacts on Plankton

The major sources of impact on phytoplankton and zooplankton communities will be from 1) drill muds and cuttings, 2) discharges of formation waters, 3) discharges of domestic and sanitary waste 4) gas blow-outs and gas pipeline breaks and 5) oil spills (chronic and acute).

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Drill Muds and Cuttings

In the conditional mean case, 17 exploratory wells and 473 production wells are expected over the 30 year lifetime of the proposed. Wells from proposed Sale No. 52 will generate a total of 341,700 barrels

of drill muds and 10,797,644 barrels of cuttings (USGS, 1980). The heavy cuttings quickly settle to the bottom around the platform. The major impact from drill cuttings will be on the benthic environment and are discussed in Section IV.C.4. Field studies (Ray and Shinn, 1975; Ecomar, 1978) have indicated that drill cuttings do not significantly increase the water column turbidity around a platform and therefore little if any impact would be expected upon the plankton population in the water column.

Drill muds consist of clays, barite, and small amounts of organic and inorganic chemicals. Materials allowed to be used in drilling muds are described in Section IV.C.2. In the conditional mean case each of the 15,250 ft exploratory wells will use 20,100 barrels of commercial mud, while 17,320 ft developmental wells will use 22,828 barrels of commercial mud. Turbidity from discharged mud will decrease the transmittance of light in the vicinity of a platform (generally within about 1,500 meters, Ayers et. al., 1980) thus reducing light availability to phytoplankton and temporarily reducing photosynthesis and primary production. Monitoring studies for the drilling of a stratigraphic test well, C.O.S.T. Atlantic G-1 on the Georges Bank, confirmed even a more rapid rate of dilution. Suspended solids ranged from 0.1 to 5.8 mg/l at a distance of 100 m from the discharge point. Location of the upper plume proved very difficult to find (ENDECO, 1976). There was no evidence of soluble barium above normal seawater levels beyond the immediate 300-foot location of the rig (the rig was 300 feet on a side).

In the less energetic portion of the proposed sale area on the continental slope, dispersion of the turbidity plume will not be as rapid and will decrease photosynthetic activity near the platform by obstructing the penetration of light, depending on temporal physical oceanographic conditions.

Based on phytoplankton biomass (productivity and cell density) on Georges Bank, the most productive areas are outside the proposed Sale area (EG&G, 1979a, a, and c, and 1980) in the Great South Channel and the northern flank of Georges Bank. Moderate values occur along the 100 meter contour (16.8% of the proposed Sale) and the lowest values characterize the southern flank deeper than 100 meters (83.2% of the proposed Sale). Sampling at a Tanner Bank platform off California indicated ph, disolved O_2 and salinity returned to background level at less than 100m downcurrent while normal transmittance levels were not restored until 200m downcurrent (Ecomar, 1978). The proposed Sale area is outside the areas of highest phytoplankton productivity (i.e. Great South Channel and northern flank), therefore any impact because of decreased transmittance should have no measureable effect on the overall primary production on Georges Bank. Seasonally, high plant cell densities may be as deep as 30 meters, but significant primary production occurs in the upper 10 meters above the discharge plume.

Considering the transient nature of phytoplankton populations moving with the currents around platforms, and short regeneration times it is unlikely any significant impact will result from this turbidity even in the less energetic slope environment. National Pollutant Discharge Elimination System (NPDES) permits for Sale No. 42 require discharging with a combination of pre-dilution (mixing with seawater as discharging occurs at 10:1 ration), controlling discharge rates (maximum 30 barrels an hour), and shunting to the depth of 10 m. to mitigate any impact in phytoplankton productivity. The effects of drilling mud discharges should have only a minor and probably negligible impact on total phytoplankton productivity in the proposed Sale area.

Drilling muds and its components can be toxic to marine organisms (EPA, 1981). The most sensitive organisms have been reported to be the plankton. Bioassays on Acartia tonsa (a neretic species of zooplankton resulted in 96-hr LC-50 (lethal concentrations to kill 50% of the test organisms in 96 hours) of 100 ppm when exposed to two mud types. Skeletonema costatum (a common diatom found in the proposed Sale area) was less sensitive than Acartia. These lethal concentrations will probably occur only near the point of discharge of the drilling muds. Rapid initial dilution rates of 500 to 1000:1 would be within a few meters of the downpipe (Dames & Moore, BLM ESP 1981).

Barium in the form of barium sulfate (barite) is a major component in drilling fluids, often comprising 80 to 90% by weight of the chemical components added to prepare a drilling mud. A major finding of the Dames and Moore (1981) literature review of laboratory bioassay was the most used drilling fluids typical of those to be used on Georges Bank (EPA-NPDES Permits, North Atlantic, 1981) are not likely to cause acute damage to marine organisms. The most toxic drilling fluid evaluated to date has a 42-day, LC-50 value for oppossum shrimp of 50 ppm of whole mud. It is estimated that dilution ratios of 100:1 for most drilling fluids and 20,000:1 for the most toxic drilling fluid evaluated would reduce the concentrations in the receiving water below acutely toxic levels. (Dames and Moore, 1981).

Drilling muds also contain heavy metals (see Section IV.C.2). However, almost no work has been done on the "bio-availability" of these metals to plankton, nor on their effects or concentration in plankton. Acute lethal effects of exposure to drilling fluids has been extensively studied (Petrazzulo, 1981). These studies have tested drilling fluid towards 48 species including representatives for 11 groups; plankton, copepods, isopods, amphipods, gastropods, decapods, bivalves, echinoderms, mysids, polyshaetes, and finfish. A total of 303 toxicity tests have been performed to determine 96-hour LC-50's values. These values have been segregated into several broad ranges and have been compared for their frequency. The conclusion drawn from these data is that for the fluids and species tested, the acute lethal toxicity of drilling fluids is generally very low (Petrazzulo, 1981).

The sublethal effects of exposure to drilling fluids have predominantly been described for metal accumulation, although a few studies on growth, behavioral, historical and enzymatic changes have been reported. Exposure of amphipods (Onisimus, Boekosimus), bivalves (Mytilus, Rangia, Crassostrea, Placopecten), and shrimp (Palaemonetes) to drilling fluids resulted in accumulation of a variety of metals, most notably barium (Ba), chromium (Cr), cadmium (Cd), lead (Pb), and zinc (Zn). The accumulations were relatively small, and with the exceptions of Ba and Zn, remained in the 1-10 ppm range (Petrazzulo, 1981). Uptake kinetics indicate a plateau in metal accumulation frequently occurs between days 7 and 15; it is not clear this plateau would continue to be maintained over longer periods because these tests ranged from 7-30 days. Depuration appears to be effective at reducing metal accumulations releasing 50 to 100% of the excess accumulated metals (Petrazzulo, 1981). Data on the assimilation of heavy metals by test organisms in bioassay tests in Cook Inlet, Alaska were highly variable and inconclusive (Dames and Moore, 1978). McAuliffe and Palmer (1976) have summarized the published toxicity data for drilling fluid components. Impacts of drilling muds on fish eggs and larvae are discussed in Sections IV.C.8 and IV.C.9. With the dilution factors expected, any effects on the plankton should be located within a few meters around the point of discharge depending on the immediate physical oceanographic conditions. To protect the early life stages (eggs and larvae) of the marine organisms of Georges Bank, the NPDES permits for Sale No. 42 required that the discharge be shunted to a depth of 10 m, that the discharge be pre-mixed with sea water and that the discharge not exceed a maximum rate of 30 barrels per hour (March 1 to August 31). The objective is to dilute the discharge prior to entering the water column, and to keep the discharge below the maximum concentration of eggs and larvae in the water column.

Concerns were raised during the scoping process of drill muds and oil spills being entrained in Gulf Stream rings and transported into the Mid-Atlantic. During the passage of an eddy through the proposed Sale area in the fall 1977, EG&G (1980) reported that about 12% of the water of Georges Bank was drawn off. Approximately 75% of the replacement of this water came from the eddy itself; the remaining water has its source in the Gulf of Maine. Satellite data show between five and ten eddies per year passing through the proposed Sale area, causing a net exchange of Bank waters of 10-20% (EG&G, 1980). The passage of these rings off of the proposed Sale area does pull water off the Bank, but with the exception of the highly mixed leading edge of the eddy, none is entrained into the eddy itself. Because of the physical oceanographic characteristics of these eddies, they would not be expected to be a transport mechanism of drill muds or oil into the Mid-Atlantic.

Formation Waters

Waters associated with oil and gas pools, called formation waters, are often produced during oil and gas production. Over the 30 year production life of the field, 1.7 billion barrels are expected to

be discharged from 20 production platforms. Formation waters contain hydrocarbons, dissolved mineral salts, and heavy metals, and are denser than seawater and devoid of oxygen. EPA standards limit the hydrocarbon concentration of discharged formation waters to 30 ppm. Over a 30 year production life of the field, 51,900 barrels of oil will be chronicly discharged with formation waters. The first year of production, could result in 2,376 barrels of oil being discharged, with a peak year of 4,342 barrels of oil associated with discharged formation waters. Dilution models have indicated that the areal extent of increased hydrocarbon levels around a platform will be 0.1 square miles for concentration over 10 ppb, and 0.001 square miles for a concentration over 1 ppm (Massachusetts Institute of Technology, 1973). Concentrations over 100 ppb would tend to stimulate growth in some species of phytoplankton and inhibit other species, and would tend to adversely affect zooplankton eggs and larval development.

Formation waters also contain dissolved mineral salts and inorganic compounds. The concentration of these materials will not be known until commercial quantities of oil are discovered in the proposed Sale area.

Domestic and Sanitary Wastes

It is estimated that 6,000 gallons per day of sanitary waste are produced for a typical exploration well and 5,000 gallons per day for a development well (FEIS for Sale No. 49). The discharges are subject to EPA NPDES permitting procedures (See Section IV.C.2). Plume studies (Massachusetts Institute of Technology, 1973; Mobil Plume Model, 1976) have indicated that the effluent is rapidly dispersed and diluted. Concentrations within the water column at any given time would be very small and of no biological significance to planktonic organisms.

Gas Blowouts/Gas Line Breaks

Two gas pipelines are expected under the conditional mean case scenario. Each is assumed to be approximately 200 miles long and to landfall along the southern shore of Little Compton, Rhode Island. Breaks or ruptures of gas pipelines could occur. The release of natural gas into the ocean would increase the levels of the light molecular weight hydrocarbons (C2 to C5). Studies in the Gulf of Mexico near underwater 'flares' have shown that high hydrocarbon levels from one source were observed in the surface water over an area greater than 25 square miles (Parker, 1974). A study around a platform blowout found that methane, ethane, and propane concentrations decreased by several orders of magnitude within a mile of the seep, but samples taken 10 miles from the blowout had concentrations higher than background levels (Brooks and Bernard, 1977). However, there were no observed environmental effects on phytoplankton at these high hydrocarbon levels near the blowout (Brooks and Bernard, 1977). Therefore, a gas pipeline break or blowout should not adversely impact plankton populations.

Oil Spills (Acute and Chronic)

The major potential impacts on phytoplankton from this proposed action would result from oil spills into the surface layers of the ocean from several sources. Chronic, low level hydrocarbon input includes small spills (less than 1,000 bbl), from accidents and normal day-to-day operations, the addition of entrained hydrocarbons from discharges formation waters, and low-level discharges from tanker loading and off-loading operations. An estimated 10 spills greater than 1,000 barrels over the lifetime of the field are expected from the proposed Sale.

Phytoplankton are considered to be among the most sensitive marine organisms to oil (Anderson, 1975). Depending on the concentrations, petroleum can be toxic (greater than 0.1 ppm), can retard growth (60 to 200 ppb), and can stimulate growth (less than 50 ppb). The response depends on concentrations, type of petroleum, light intensity, and the season. The most severe impact of a major oil spill on the phytoplankton in the study area would occur in the spring and summer months when the productivity and standing crop are highest. Phytoplankton cell division could be depressed if hydrocarbon concentrations in the water colum are much higher than 1 ppm. A model is presently being developed by the University of Rhode Island for BLM assessing the impact of an oil spill on fish eggs and larvae and the resultant economic impact on the fishing industry. The effects of an oil spill on plankton populations might be acute directly under a spill, but these populations should recover over a seasonal cycle because of their high reproductive potential.

The National Academy of Sciences (1975) stated that there is no evidence for food web magnification for petroleum hydrocarbons in the marine environment. NAS also concludes that phytoplankton can absorb oil onto their cell walls, but no transfer of hydrocarbons into the cell occurred at the low levels found in the marine environment.

Copepods are the predominant zooplankton of the proposed Sale area. Copepods have been found to retain hydrocarbons long enough to be transferred to a higher trophic level (Corner *et al*., 1976). However, higher trophic levels, such as fish and shrimp can metabolize hydrocarbons (Anderson *et. al.*, 1974). The ingestion and elimination of oil by zooplankton may be an important pathway for transporting oil to the sediments. Zooplankton have been observed ingesting large quantities of small droplets of oil, and eliminating the oil in their fecal matter (Canover, 1971).

After actual oil spills, the high concentrations returned to background levels within a few days (Grosse and Mattson, 1977), or within a few miles of the spill site (McAuliffe *et*, *al*., 1975). The impacts of a spill would probably be an initial reduction in planktonic populations, and a short-term accumulation of hydrocarbons in zooplankton populations. Phytoplankton and zooplankton populations would be expected to recover rapidly after the spill, due to their short regeneration times (Hyland and Schneider, 1976). The recovery of fish eggs and larvae would be slow, and would depend on the species affected, and its reproductive cycle. Impacts to fish eggs and larvae are discussed in Section IV.C.7.

Because of the highly energetic physical oceanographic regime in the proposed Sale area and short planktonic regeneration times,there should be little if any impact on planktonic communities due to oil and gas development.

Conclusion: The likelihood of significant impacts on pelagic plankton from drilling muds and cutting discharges is remote both during exploration and production phases. The probability that a significant portion of the population would be destroyed, even with a major oil spill, is low.

CUMULATIVE IMPACTS

The previous and proposed lease Sales will result in certain unavoidable impacts to plankton populations. Impacts will result primarily from oil spills and the discharges of drilling muds and cuttings.

It is estimated that approximately 236,000 tons of drilling muds and 736,000 tons of drill cuttings will be discharged as result of Sale No. 42 and 11,601,962 barrels of muds and 1,840,651 barrels of cuttings from the proposed Sale. Increases of turbidity will result in a reduction of transmissivity in the water column and a subsequent reduction by physical abrasion, and a reduction of respiratory and feeding efficiencies. Studies (Dames and Moore, 1978; Ecomar, 1978) found the discharges to be diluted 500:1 to 1000:1 within 3 meters of the discharge point, with an additional 100:1 dilution within 100 meters. Monitoring of the C.O.S.T. well G-1 on Georges Bank also showed rapid dilution of drilling discharges (ENDECO, 1976). Suspended solids ranged from 0.1 to 5.8 mg/l at a distance of 100 meters from the discharge point, and the location of the upper plume down current proved to be difficult. Therefore, it is expected that any impact on the plankton will be minimal and immeasurable from the total plankton productivity on Georges Bank due to drill muds and cuttings.

Considering the cumulative impacts of the proposed Sale and all existing OCS Sales in the Mid- and North Atlantic region, a total of 25 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of these sales. Eleven spills greater than 1,000 barrels are expected from Sale No. 42 and the proposed Sale. The deleterious effects of oil and gas activity on plankton populations, especially oil spills, is felt to be nonsignificant, due to the spatial and temporal variability of plankton in the marine environment (Strickland, 1967; Riznyk, 1977; Balech, 1960). Plankton trapped within spills will experience mortality but replacement by advected populations should occur rapidly after the oil has dissipated, weathered, or transported from the area.

Chronic low-level pollution can cause sub-lethal changes in organisms and communities. Food-web magnification of petroleum hydrocarbons may occur. Accumulation of petroleum hydrocarbons (PHC's) is probably a function of the organisms ability to metabolize and depurate the petroleum rather than the organism's position in the food web. Another unknown area of possible concern is that of the synergistic effect of all of the pollutants, especially oil, trace metals and polychlorinated biphenals (PCB's). PCB levels are presently high in the plankton of the Atlantic. The introduction of oil may produce a combined effect much worse than the effects of either oil or PCB's alone. Subtle effects, carcinogenicity, and synergistic effects of oil are three areas that need further research to accurately predict their effects.

Conclusion: Cumulative impact on plankton should be minimal and immeasurable from the total plankton productivity on Georges Bank.

ALTERNATIVE 2: DELAY THE SALE

The impacts of a Delay the Sale Alternative would largely be the same as described under Alternative 1, but they would occur at a later time. If delay was for the purpose of awaiting new information, it is presumable that such information could result in improved environmental safeguards which might lessen the environmental impacts. However, the scope of the possible information, its importance, and what controls might be devised are currently unknown. Additionally, the delay alternative could allow for the development of improved technology, increased recovery capacity, and safer oil and gas operations, thus providing more resource recovery with reduced risk to the environment. The difference in impacts between the alternative and the proposed action is unknown.

Conclusion: Delaying the proposed Sale would not change the impacts expected under the proposed action but delay them to a later time.

ALTERNATIVE 3: CANCEL THE SALE

Lease Sale No. 42 has already taken place in the North Atlantic, so that some drilling related adverse impacts to planktonic communities will occur if the proposed Sale is cancelled. The no-sale alternative would eliminate environmental impacts on plankton communities associated with the proposed Sale. The expected oil spill risk would be greatly reduced. The area would continue in its present condition as further modified by natural processes and the continuation of all existing offshore and onhsore activities and uses.

Conclusion: With the alternative of no sale there will not be any adverse impacts on planktonic communities resulting from the proposed Sale. Some drilling-related impacts will result from Sale No. 42, and oil spills from existing tankering would likely continue.

ALTERNATIVE 4: DELETE 49 TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

Under this alternative, approximately 91% of the total tracts in Alternative 1 will comprise the Sale. The highest areas of primary productivity in the proposed Sale area are located on the shelf and along the shelf break.

Since 491 of the total proposed Sale of 540 comprise this alternative, and the deleted tracts on the continental rise are located outside areas of high planktonic productivity, the impacts on plankton from this alternative will be very similar to Alternative 1.

Conclusion: The impact on planktonic communities from this alternative will be indistinguishable from Alternative 1.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts would leave 335 tracts in deeper water under this alternative. In the proposed Sale area, regions of highest plankton productivity are located along the continental shelf and shelf break. The impact of this alternative would be to decrease any impact on plankton populations which are important link in the food chain of the area. Impacts on the continental slope and rise planktonic populations would be the same as under Alternative 1.

Conclusion: Under this alternative, impacts on planktonic populations on Georges Bank will be significantly reduced. Impacts on planktonic slope and rise communities will be identical to Alternative 1.

ALTERNATIVE 6: DELETE 33 TRACTS IN CANYON HEADS' VICINITY

Deletion of these 33 tracts because of the small area involved would have an insignificant influence on the planktonic population of the proposed Sale area.

Conclusion: Under this alternative, impact on planktonic populations will be similar to Alternative 1.

ALTERNATIVE 7: GEORGES BANK MARINE SANCTUARIES

The barging of drill muds and cuttings on 33 tracts would leave 94% of proposed Sale discharging into the marine environment and impacts would not be differentiable from Alternative 1. Controlling the discharges within the sanctuary would decrease any possible short-termed impacts because of shunting to a depth of 10 m., pre-dilution at a 10:1 ratio and restrictions on maximum discharges. Impacts to the plankton on the slope and rise will be identical to Alternative 1. Piping oil outside the sanctuary would mitigate any possible impact on plankton from chronic discharges associated with offshore loading of tankers.

Conclusion: Because of the tremendous reproductive capabilities found in planktonic population, under the restrictions on oil and gas development under sanctuary designation the impact would be similar to Alternative 1.

ALTERNATIVE 8: DELETE 94 TRACTS CONTAINING POSSIBLE SEDIMENTS SLUMPS

Under this alternative, approximately 18 percent of the proposed Sale area will be deleted. All of these tracts are located on the continental slope in possible slump areas. These tracts are outside the area of highest planktonic productivity within the proposed Sale area and therefore any impact will be similar to Alternative 1.

Conclusion: Impacts to planktonic communities will be similar to Alternative 1.

4. Impacts on Benthos

The major factors which will impact the benthic environment from the proposed Sale are oil spills (acute and chronic) and drilling muds and cuttings.

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Major mortalities on benthic invertebrates have resulted from nearshore oil spills, such as the *Florida* spill in Buzzards Bay, Massachusetts (Hampson and Sanders, 1969; Blumer *et. al*., 1971) and the *Poling* spill near Portsmouth, New Hampshire (Mulligan *et. al*., 1974). Sublethal effects result from cellular and physiological interferences, usually leading to some form of abnormal behavior, particularly disruption of normal feeding and reproductive patterns (Moore, 1973). Habitat recovery is slow, especially if the oil spill impacts mud-flat areas, estuaries, or semi-enclosed embayments. Recovery would probably require a minimum of ten years to return to a normal distribution (Moore et. al, 1974; Hyland and Schneider, 1976; Vandermuellen and Gordon, 1976). An Oilspill Trajectory Analysis Model (OSTAM) was used for five commercially important inshore benthic species (see Section IV.C.7).

The impacts of a spill to benthic organisms will depend largely on the amount of oil that sinks. Gordon *et. al*. (1976) found that in field experiments less than 5% of the spill entered the water column and sediments. Following the *Argo Merchant* spill, less than 0.1% of the spilled oil was found in the sediments (Hoffman and Quinn, 1978). If the oil sinks, or is driven into the sediments by wave turbulence (Forrester, 1971), then the impact on the benthos could be severe. Vertical mixing inside the 60-meter isobath on Georges Bank is primarily due to wave action which could drive oil into the sediments. Only 7 tracts of the proposed Sale are within the 60-meter isobath, and many complex factors such as winds and currents would also influence the depth that oil could be driven into the sediments. However, for the Georges Bank area, the Council of Environmental Quality (1974) estimates the recovery time for sandy sediments to be of a two to three year duration.

Impacts would not be limited to the initially affected area since oiled sediments can be resuspended and transported by bottom currents (Grose and Mattson, 1977). Sediment movement could transport the oiled sediments near lobster areas at the heads of canyons. First-stage lobster larvae are one of the most sensitive forms of aquatic organisms to oil (Wells and Sprague, 1976). Recovery of the affected fine sediments in the heads of canyon could be slow. As part of a Biological Monitoring Plan, two regional stations have been established at the heads of Lydonia and Oceanographer Canyons to monitor any possible impact from Sale No. 42.

Benthos may be exposed to oil in the form of fecal pellets from Zooplankton; the amount of oil and its effects on the benthos is not known. The majority (67.5%) of the proposed Sale area is on the continental slope and rise. If large quantities of oil were deposited by grazing zooplankton onto the fine sediments, or by adhering to suspended particles, the impact on the benthos could be severe and tend to persist, especially in the intercanyon deposition areas (See Section IV.B.2), an area characterized by relatively low relief, monotonous surface. The only areas of active sediment transport within the slope and rise appears to be the submarine canyons.

Low-level chronic oil spills can result in long-term accumulations of hydrocarbons in sediments and biota (Farrington and Quinn, 1973). Studies in Lake Maracaibo, Venezuela and in the Santa Barbara Channel, California, have not found detectable accumulations of petroleum hydrocarbons in the invertebrates analyzed (Templeton _et_. _al_., 1975; Mearns and Moore, 1976).

Drill Muds and Cuttings

The ocean currents in the proposed Sale area are likely to transport the bulk of effluents off the Bank and into three potential sinks: the southern portions of the Gulf of Maine, the "mud patch" off Rhode Island, and the canyon heads along the southern flank of Georges Bank.

The degree of impact of drilling fluids and cuttings on benthic and demersal species is highly dependent on local environmental conditions (depth, currents, wave regime, substrate, etc.) and on the nature and volume of the discharges, including cutting sizes and depth of discharge.

In dynamic areas (similar to the area of the proposed Sale on Georges Bank) both _in situ_ bioassays and benthic sampling have shown little evidence of effects on infauna or on epibenthic crustaceans at distances of 100 meters or greater from the well (Dames and Moore, 1981). Disruption of benthic communities within 25 to 50 m of the well must be assumed due to seafloor discharge of cuttings during placement of the collector pipe and due to placement of the baseplate, if used.

Seven tracts of the proposed Sale are located in water depths less than 60 m. Dames and Moore (1981) hypothesized that drilling fluids could ultimately be concentrated within the Georges Bank gyre. They assumed an average depth of 30 m within the 60-m contour, therefore the volume is $4.71 \times 10^{11} M^3$. Assuming a volume of mud solids of 1.1×10^7 kg/yr to be entrained and evenly mixed, the concentration would be 0.023 mg/l (ppm) mud solids. Proportionally, the total barium concentration would be 0.01 mg/l, chromium would be 0.00004 mg/l. These concentrations are comparable to or well below natural background concentrations of soluble barium and chromium in seawater. Zinc would be about one-third the chromium level and all other metals would be an order of magnitude lower than chromium. Therefore, an impact on the biota in the gyre from drilling muds and cuttings would not be expected.

On Georges Bank, 85 tracts, 15.7% of the proposed Sale, lie in water depths between 100 and 200 m. At theses depths, storms will resuspend muds and disperse cuttings. In the shallower waters of less than 100 meters (16.8% of the total), the physical oceanographic dynamics are so strong that no prolonged accumulation of drill muds or cuttings is possible. No cuttings were evident 3 years following drilling of the C.O.S.T. well G-2 (in about 79 m) on the southern flank of Georges Bank. Effects resulting from physical alteration of the bottom (e.g. cuttings or mud accumulations) that change sea floor topography or grain size will tend to revert toward their predrilling conditions at a rate directly proportional to the rate at which natural processes are affecting the bottom.

The flow of water along the southern flank between 60 and 100 m is primarily along the isobath. It has been estimated that 70% of this flow leaves the Bank at the southwest corner and crosses the Great South Channel where the muds are presumed to be deposited in the "mud patch" south of Rhodes Island. The remaining 30% eventually flows into the Gulf of Maine or continues around the Bank and exists at other locations. In water depths greater than 100 m along the south flank, it is likely the flow is down the slope towards the canyons and deeper waters.

Along the south side of the proposed Sale area there is a sub-surface band of cool water bounded by the Bank on the north and by the shelf slope water on the ocean side, and capped by the thermocline above. It is a feature that extends from the Northeast Channel to Cape Hatteras, a distance of more than 600 miles. Speeds of flow have been estimated at 5 cm/sec flowing southwestward. The cold band is approximately 20 miles wide and 150 feet deep, with an approximate volume of 200 billion barrels of water per mile. Therefore, any drilling effluents entrained in the cold band will become dispersed in this large volume of water and move away from the proposed Sale area towards the southwest.

Hecker et. al. (1980, BLM ESP) reported on the distribution and abundance of various animals including soft and hard corals in about 10 submarine canyons which included Oceanographer and Lydonia in the proposed Sale area. They noted faunal densities higher than on the slope, suggesting that this is probably a consequence of higher nutrient flux and greater substrate variability. Increased suspended sediments due to drill muds and cuttings could cause damage to coral populations by covering rock, fouling the colonies or abrading their tissues.

Extensive laboratory testing has demonstrated that the bulk of materials present in drilling fluids (e.g. barite, bentonite) are relatively non-toxic chemicals but contribute to high suspended solid levels. A significant increase of suspended solids could adversely affect sessile filter-feeding organisms such as corals and sponges in canyon areas. Conditions in some canyon areas may allow a gradual temporary accumulation of sediment when the normal oscillatory current velocities are low. Periodically, storms result in high current magnitudes which would be capable of flushing out the sediments, including drilling muds. Should any of the drilling effluents actually be transported to the continental rise, their incorporation into the nepheloid layer on the rise would result in its dispersion and eventual deposition over a tremendous expanse of ocean floor. Concentrations of drilling related solids would be undetectable and physical and chemical effects of drilling solids deposition would be undistinquishable.

On Georges Bank in less than 200 m (or 32.5% of the proposed Sale) the presence of drill cuttings is unlikely to have any significant adverse effect on benthos other than very localized burial of some infauna. Within one of several years the cuttings and their associated impacts would be likely to be undetectable due to resuspension and transport. Monitoring of soluble barium and chromium concentrations in the vicinity of the C.O.S.T. Atlantic G-1 well (Visual No. 1) showed no significant influences within 100 m of the discharge. Laboratory experiments verified that the amount of barium and chromium which dissolves in seawater was a small fraction of the particulate bound fraction. Concentrations of dissolved barium showed a mean value of 37+ ug/l near the rig, dissolved chromium could not be found in concentrations above normal seawater background (ENDECO, 1976).

Reports available from a Mid-Atlantic well monitoring study leave open the possibility that a significant reduction in benthos, changes in grain-size distribution, clay mineralogy and increase in metal levels may have extended up to 3,2000 m or farther downcurrent from the well site (Dames and Moore, 1981). This is the only deep water (greater than 100 m) study reported to date, from a relatively low, near-bottom energy regime. Sediments in the range of Phi 4 or smaller comprised 16% of the Mid-Atlantic sediment near the rig, which would be analogous to depths greater than 200 m in the proposed lease area. Recognizing that sediments components are infuenced by many factors in addition to currents and storms, the extent of biological effects apparently observed at the Mid-Atlantic well could occur in the deeper regions of the slope where comparable amounts of fine sediments are

present. In summary, the Mid-Atlantic study concluded that the discharge of drilling fluids and cuttings did cause local and at least some short-term effects on the fauna in the vicinity of the well site. Increases and/or decreases in abundance were probably related to (1) physical alterations of the substrate, e.g., rapid deposition and burial, increased surface relief or increased clay content of the sediment, as well as (2) effects of predation by hake, crabs, and starfish. No toxic effects were identified. Completion of data processing and re-analysis of data from the Mid-Atlantic study may provide information concerning the extent discharges can alter the physical and chemical properties of sediments in the vicinity of wells drilled in deep water.

It is possible that adverse impacts on the benthic environment will be greater around wells in the inter-canyon slope areas despite the fact that benthic organisms are more abundant in shallower waters on the Bank. In deeper water, increased trajectories through the water column disperses drilling fluid and cuttings over a larger area of bottom initially, but dispersion following deposition would take longer than in shallower waters of the proposed sale area on Georges Bank. Due to the many variable factors which affect the potential transport routing, it is extremely difficult to project the quantity of material which might be transported to a given area.

In the proposed Sale, 404 of the presumed 473 production wells will be drilled in depths greater than 200 m. Over the proposed 30 years life of the field, 9,222,512 barrels of drilling muds will be discharged into the slope environment. The discharge could cause changes in grain-sized distribution, clay, minerology and increased metal levels which could impact the benthic infauna of the continental slope.

Estimating the physical and chemical effects on the continental rise is extremely difficult. The current knowledge of the physical and biological environment does not allow one to draw reasonable limits on the area likely to receive drilling-related sediments. The existence of local mechanisms (i.e. slumping) to transport these sediments out of the slope environment further complicates analysis.

In summary, the percent weight of fine particles in natural sediments can be taken as a measure of the likelihood of drilling muds remaining in the area of the well after deposition. The very small percentages of fine particles found in less than 100 m in the proposed Sale area suggests that deposited drill muds would remain in the vicinity of the initial deposition for a very short period of time. In contrast, drilling muds deposited on the bottom in depths greater than 200 m would have a significantly greater residence time near the well. These conclusions are substantiated by the results of sediment mobility studies on Georges Bank (See Section IV.B.1). In conclusion, very little initially deposited drilling muds or cuttings will remain for a long duration on the Bank. The deeper inter-canyon slope areas and the continental rise, in contrast, could be areas of long-term deposition of any initially deposited drill muds and cuttings.

Bioaccumulation

Information concerning bioaccumulation has been summarized by Dames and Moore (1981, BLM ESP). Both field and laboratory data have shown that marine animals can bioaccumulate heavy metals from drilling fluids, thereby introducing them into the food chain and creating the potential for concentration in commercial resources and/or ingestion by humans.

Researchers using a variety of marine species such as shrimp (*Crangon*, *Pandulus*), sand worms (*Nereis virens*), mussels (*Mytilus edulis*) and clams (*Rangia cuneata*) have demonstrated the uptake of various metals, including Cr, Cd, Pb and Zn (Page *et al*, 1980; McCullough *et*. *al*., 1980). After depuration periods of 4-14 days, significant quantities of Cr and Pb remained in the clam *Rangia cuneata* (McCullough *et*. *al*., 1980).

In the Baltimore Canyon study, Mariani *et*. *al*. (1980) found elevated levels of barium (Ba) and mercury (Hg) in starfish, molluscs and polychaetes. Barium levels in molluscs rose from less than 5 ppm before drilling to levels up to 322 ppm with most post-drilling values falling in the 5--100 ppm range. No correlation between metal concentration in the sediment samples and tissue samples was detected, but this is probably due in part to the field sampling and analytical procedures used (Dames and Moore, 1981).

Baltimore Canyon field bioaccumulation studies have been supplemented by another sampling of the area twelve months after the discharges ceased; this information will be evaluated when available.

The fraction that immediately dissolves from discharged drilling fluids may not be the only source of exposure for bioaccumulation. There are indications that a significant method of uptake may be through the solid fraction. Benthic organisms which feed on bottom sediments may become contaminated with heavy metals. Also, benthic animals may be subjected to a more continuous supply of soluble metals as they slowly leach out of bottom sediments and interstitial waters (EPA, 1981).

The EPA permits for Sale No. 42 require that an ambient monitoring program be underway before discharges commence which will provide information to complete the unreasonable degradation decision by EPA (NPDES permits for North Atlantic 1981). The monitoring program will provide information on the physical/chemical makeup of the discharges, the fate near the drill rigs and potential depositional areas. This program will provide effluent controls sufficient to prevent unreasonable degradation of the Georges Bank environment. There is also a provision in the NPDES permits that they can be revoked or modified at any time if, on the basis on new data, EPA determines that continued discharges may cause unreasonable degradation of the marine environment.

EPA does not believe that irreparable harm will occur on Georges Bank itself, since there is good evidence that drilling discharges will be transported off the Bank. The fauna on Georges Bank are subject to frequent physical disturbances (Butman, 1980) and any changes induced by sedimentation of discharges will be reversed once the materials are removed, since the fauna have high recolonizing potential (EPA, 1981).

Conclusion: Because of the highly energetic physical environment on Georges Bank, there should be little long term impact on the benthos from the proposed Sale. There will probably be some unavoidable benthic population reduction in the intercanyon areas due to changes in sediment characteristics brought about by discharged drill muds and cuttings. The ingestion and elimination of oil by zooplankton may be an important pathway for transporting oil to the sediments and in such depositional environments found in the inter-canyon areas and continental rise, long-term impacts to the benthos may result.

CUMULATIVE IMPACTS

The previous and proposed lease Sales will result in certain unavoidable impacts to the benthos. The impacts will result primarily from oil spills, discharges of muds and cuttings, discharges of formative waters, discharges of domestic and sanitary wastes, pipeline burial, and gas blowouts and gas line breaks. It is estimated that approximately 236,000 tons on drilling muds and 738,000 tons of drill cuttings will be discharged as a result of Sale 42, and 11,601,962 barrels of mud and 1,840,651 barrels of drill cuttings from the proposed Sale. The discharges will result in the burial of benthic organisms and possible toxic effects near the discharges.

Considering the cumulative impacts of the proposed Sale and all existing OCS Sales in the Mid- and North Atlantic region, a total of 25 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of these sales. Spills could severely impact eggs and larvae. If the oil sinks, the impact on the benthos could be severe, as the fine sediments of the continental slope and rise would tend to retain the oil, slowing down the weathering processes. Peracaridean crustaceans, abundant along the outer shelf, have shown to be among the most sensitive of the benthos to oil pollution. Recovery of the affected area from a large spill would be slow, probably requiring a minimum of ten years to begin to return to a normal distribution of the biota.

Oil spills could have severe impacts on nearshore communities. Recovery time for exposed sandy beaches would be from three to five years and for estuaries or semi-enclosed bays greater than 10 years.

Sanitary and domestic wastes will be discharged from drilling rigs and production platforms. Plume models have indicated that the effluent is rapidly diluted and dispersed. Therefore sanitary and domestic wastes will probably not have a significant impact on marine organisms.

Conclusion: There could be some unavoidable benthic population reduction in the intercanyon areas due to changes in sediment characteristics brought about by discharged drill muds and cutting: overall impact to the benthic environment will be of a minor nature.

ALTERNATIVE 2: DELAY THE SALE

Delaying the proposed Sale would not change any impacts unless ongoing studies identified impact from oil and gas operations which could be mitigated through operating orders or stipulations. The proposed sale could be delayed until completion of certain enviromental studies in the North Atlantic: 1) The New England Outer Continental Shelf Physical Oceanography Program funded by BLM will identify and quantify the physical processes involved in the transport and dispersion processes on Georges Bank. This program will aid in identifying transport mechanisms of drilling effluents on Georges Bank. 2) The Lamont-Doherty Study funded by BLM will be available in August of 1983. This study is to examine the oceanographic processes in canyons and slopes in order to determine what their role might be in transmitting drilling pollutant to the benthic environment. 3) A study concerning the economic cost from oil spills to commercial fishing on the North Atlantic OCS area has been lent to the University of Rhodes Island. Preliminary information is available and the study will be completed by September, 1982.

The Biological Task Force monitoring plan has been accepted and initial pre-drilling stations will be in place by the summer of 1981. Information from the monitoring plan for exploratory drilling for Sale No. 42 could provide information to BLM on any possible impacts associated with oil and gas development on Georges Bank. As scheduled, the proposed lease Sale No. 52 would take place in October, 1982, if the decision is made to hold the sale.

These studies could produce information useful in developing biological stipulations, invoking lease stipulations, developing regional operating orders, developing transportation management plans and other mitigating measures more specifically designed to the proposed lease area, so that during production, oil and gas resources could be most advantageously exploited while providing maximum protection to the environment.

Conclusion: Delaying the proposed Sale would not change the impacts expected under Alternative 1. A delay could allow time for the BLM-funded studies to be completed and information to become available from the monitoring plan for Sale No. 42. However, the results of these studies will be available for use in post-sale decisions even if the sale is held as scheduled.

ALTERNATIVE 3: CANCEL THE SALE

Lease Sale No. 42 has already taken place in the North Atlantic, so that some drilling-related impacts to benthic communities will occur if the proposed sale is cancelled. As previously described, impacts on the benthic environment on Georges Bank would be localized and of a temporal nature, therefore, cancellation of the sale would have little if any discernable change on the overall benthic community structure on Georges Bank.

It has been estimated that the tankering of crude oil and refined products in the Mid Atlantic region could result in oil spills greater than 1000 barrels over the next 30 years, with a total of 93 expected from Maine to Virginia. Adverse impacts to benthic communities from oil spills resulting from the continued tankering of crude oil and refined products through the region would still occur if the Sale were cancelled.

Conclusion: With the alternative of no sale, there will not be any adverse impacts on benthic communities resulting from the proposed Sale. Some drilling-related impacts will result from Sale No. 42, and oil spills from existing tankering would likely continue.

ALTERNATIVE 4: DELETE 49 TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

Under this alternative, approximately 91% of the total tracts in Alternative 1 will comprise the Sale. The highest areas of benthic biomass in the proposed Sale area are located in the shelf and along the shelf break. Since 491 tracts of the total proposed Sale of 540 comprise this alternative, and the deleted tracts on the continental rise are located outside areas of high benthic biomass, the impacts on plankton and benthos from this alternative will be very similar to Alternative 1.

Conclusion: The impact on benthic communities from this alternative will be indistinguishable from Alternative 1 because of the small number of tracts deleted, the physical dynamics of the regions and their location on the continental rise.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts would leave 335 tracts in deeper water under this alternative. In the proposed Sale area, regions of highest benthic biomass are located along the continental shelf and shelf break. The impact of this alternative would be to decrease any impact on benthic populations which are important to demersal feeding fish in the proposed Sale area. Impacts on the continental slope and rise benthic populations would be the same as under Alternative 1 from drill muds and cuttings.

Conclusion: Under this alternative, impacts on benthic populations would be greatly reduced: Benthic populations on Georges Bank are important as food sources to demersal feeding fish, any possible impact due to the proposed sale would be greatly reduced.

ALTERNATIVE 6: DELETE 33 TRACTS IN CANYON HEADS' VICINITY

Deletion of these 33 tracts, because of the small area involved, would have little if any influence on the planktonic communities. The North Atlantic has a coralian fauna primarily limited to hard substrate in canyon areas. Deletion of these tracts would protect any possible coral populations in the heads of Veatch, Hydrographer, Welker, Oceanographer, Gilbert, Lydonia and Powell canyons.

The steepness of the tracts in and near these canyons may enlarge the area affected by discharged drill muds and cuttings. This alternative would help protect important lobster populations in these canyon.

BLM is funding an ongoing study to examine the oceanographic processes of canyon areas and nearby slopes in order to determine their role in transmitting drilling pollutants to animal life on the ocean bottom. The shelf, canyons, slopes and the animals that inhabit them are inextricably linked and the study results will be used to develop drilling practices that will mitigate any adverse biological effects from spilled oil or drilling muds and cuttings.

Conclusion: Deletion of these 33 tracts would protect any possible coral or lobster populations found in Veatch, Hydrographer, Welker, Oceanographer, Gilbert, Lydonia or Powell canyon heads from the direct effect of drilling activities.

ALTERNATIVE 7: A GEORGES BANK MARINE SANCTUARIES

The barging of drill muds and cutting on the 33 tracts would greatly decrease any possible impact from OCS discharges to the canyon environment, protecting important lobster habitats. Impact to other 507 tracts would be identical to Alternative 1.

Control discharges on the 205 tracts within the marine sanctuary would have almost identical impact on the benthos as Alternative 1 (See Section IV.C.4).

Pipelining of oil to a moored buoy outside the sanctuary would decrease the likelihood of any impact on plankton from the onloading of oil tankers inside the sanctuary. An oil pipeline rupture could have a greater impact on the benthic environment than an onloading spill, due to its physical contact with the ocean bottom but pipelines are historically a safer mode for oil transportation than tankering.

Conclusion: The canyons areas on Georges Bank under the sanctuary designation would be protected from any possible impacts due to drill muds and cuttings. Control discharges within the sancturary would be very similar to Alternative 1. Pipelining of oil outside the sanctuary would decrease any possible impact from possible chronic oil discharges associated with tanker onloading within the sanctuary.

ALTERNATIVE 8: DELETE 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Under this alternative, approximately 18 percent of the proposed Sale area will be deleted. All of these tracts are located on the continental slope in possible sediment slump areas. In the proposed Sale area, 366 tracts are located in waters deeper than 200 m. Deleting 94 tracts on the slope due to sediment slumps would decrease the impact to the slope benthos from drill muds and cuttings. Impacts to areas of high benthic biomass found on the continental shelf and shelf break area of the proposed Sale will be similar to Alternative 1 because of the physical oceanographic regime of the area.

Conclusion: There will be a decreased impact on the slope benthic communities due to this alternative, but areas of high benthic biomass found of the continental shelf and along the shelf break will be similar to Alternative 1.

5. Impacts on Sensitive Coastal Areas

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

The types of impacts that could occur to sensitive coastal areas (e.g. bays, estuaries, coastal marshes, and beach/dune areas) from oil spills are quite numerous and highly diverse due to the complexity of these fragile habitats. The effects of an oil spill on many resources that utilize these areas such as bird species, commercial fishes and shellfish, and other aquatic invertebrates are addressed in other sections. If an oil spill were to enter a major estuary, the oil would probably strike the shoreline and become incorporated in the bottom sediments. Incorporation of oil into the sediments will retard degradation of the oil and could cause contamination to remain for up to ten years (Boesch, Hershner and Milgram, 1974) which can cause serious long term impacts to benthic organisms. Water flow patterns in estuaries tend to make them act as nutrient and pollutant traps (Odum, 1970), thus preventing spilled oil from being flushed from the system. This could increase the amount of exposure to spilled oil for many estuarine plants and animals.

Wetland vegetation bordering estuarine and coastal shorelines and salt marshes could be adversely affected by an oil spill. Generally, oiled vegetation dies but the roots and rhizomes remain viable when a spill is not too severe (Burns and Teal, 1971). Chronic pollution will have more serious effects. Baker (1971a) concluded that more than two or

three fresh oil spills a year or one or two spills per year with weathered oil could reduce marsh grass stands. A marsh near a refinery effluent was reported (Baker 1971b) to be completely denuded by chronic low-level pollution. The impacts of oil on marsh plants is further dependent upon the season (growing versus dormant) in which a spill might occur. Damage would be greatest during the spring and summer growing seasons. Since aquatic vegetation plays such a vital role in maintaining the stability of estuarine and marsh ecosystems, the permanent loss of vegetation would result in a corresponding decay of these systems.

The probability of an oil spill from the proposed lease area impacting any of the major estuaries, coastal marshes, or protected coastal areas is less than 0.5% (Table 5, Appendix D). The probability of a Sale 52 tanker spill impacting any of the major estuaries, coastal marshes, or protected coastal area is 1% or less, 17% or less, and 17% or less, respectively. The marshes and protected coastal areas most vulnerable to a Sale 52 tanker spill are those areas along the northern New Jersey shore and the south shore of Long Island approaching Raritan Bay. The projected onshore support facilities and ports expected to service the proposed lease area will be located in areas zoned for industrial development or in existing ports and are not expected to adversely impact any sensitive coastal areas.

In Narragansett Bay, three islands and their surrounding waters have been designated an estuarine sanctuary (see Section I.D.2). Although an oil spill in this sanctuary would jeopardize most of the existing sanctuary uses and wildlife resources, it is extremely unlikely that an oil spill would penetrate so far up the bay as to impact the sanctuary (see Visual No. 2). Service vessels operating out of Davisville, Rhode Island, are not expected to transit sanctuary waters.

The Cape and Islands Ocean Sanctuary of Massachusetts promotes among other things, the protection of ecologically significant marine and coastal resources. The probability of an oil spill from the proposed lease area entering this ocean sanctuary is 2% or less, but increases to 28% or less from a Sale 52 tanker spill. This indicates that a Sale 52 tanker spill could pose a significant threat to the marine and coastal resources included in the sanctuary.

The beach/dune region of the North Atlantic, from Cape Cod south, consists of a narrow strip of land essentially lining the entire coast. An oil spill impacting a natural beach could destroy dune grass (needed to stabilize the beach), saturate the sand, and require mechanical removal of contaminated sands. The removal of sand by heavy equipment would contribute further to the destruction of the beach/dune area. A spill from the proposed lease area would pose only a minimal threat to beach/dune areas (1.0% or less probability of impact), but a proposed Sale No. 52 tanker spill would pose a moderate threat to these areas (12% or

less probability of impact) particularly Cape May County, New Jersey, the western end of the south shore of Long Island, Martha's Vineyard, and Nantucket Island (Table 8, Appendix D).

The combined effect of oil spills from the proposed lease area and from Sale 52 tankers can result in an increased risk of impact to sensitive coastal areas. A total of 10 spills greater than 1,000 barrels each may occur over the production life of the sale. The probabilities of oil spills occurring and impacting sensitive coastal areas from all sale related activities over a 30 year period are listed in Tables 9 and 10, Appendix D. Among the most vulnerable areas to proposed Sale No. 52 related oil spills include the Cape and Islands Ocean Sanctuary of Massachusetts (56%), coastal marshes (30%), the western end of the south shore of Long Island (14%), and Martha's Vineyard (20%) and Nantucket Island (25%). In general, oil spills resulting from tanker accidents as opposed to oil spills from the proposed lease area pose the greater risk to sensitive coastal areas.

The relatively high number of estimated Sale 52 related oil spills combined with the high probability of impact to certain areas could result in the degradation of some nearshore and coastal areas. However, impacts to these sensitive habitats will tend to be relatively short-lived due to the natural breakdown of oil in the marine environment and to oil spill containment and clean-up operations required under OCS Operating Order No. 7 (see Appendix E). Facilities and contingency plans for the North Atlantic region are described in more detail in Section II.B.1.d.

Two gas pipelines are projected to bring gas ashore in Newport County, Rhode Island, as a result of the proposed Sale. Each of these pipelines would impact sandy beach areas. Impacts to beach areas originate from trench excavation through unstable sands and sediments that are prone to rapid erosion when disturbed. However, the sides of the trench are usually retained by sheet-piled coffer dams to avoid any serious erosion problems during trenching. Impacts are further mitigated due to the short period needed for construction and to the relative ease of refilling the trench (10 to 40 feet in width). Vegetation existing landward of the beach will be greatly disturbed or destroyed in the pipeline right-of-way (approximately 150 feet in width) during construction activities. Proper reclamation and management practices will be needed to re-establish vegetation in the operational right-of-way (40 to 50 feet in width). Woody and shrubby plants such as those found in the numerous small cedar swamps in the area would be permanently excluded from the right-of-way.

Conclusion: Sale 52 related oil spills combined with the relatively high risk of impact to certain areas could result in the degradation of some sensitive coastal areas. Oil spills resulting from tanker accidents pose the greater risk to coastal areas. Coastal wetlands and beach/dune areas bordering the entrance to the Delaware and Raritan Bays or those on Martha's Vineyard and Nantucket Island, which are included in Massachusetts Cape and Islands Ocean Sanctuary, could be exposed to a moderate to high risk of impact from the proposed Sale.

CUMULATIVE IMPACTS

Considering the cumulative impacts of the proposed Sale 52 and existing OCS sale No. 42 in the North Atlantic region, a total of 11 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of these sales. The combined probabilities of an OCS oil spill from existing sale No. 42 and the proposed sale occurring and impacting sensitive coastal areas over a 30 year period are listed in Tables 9 and 10 Appendix D. Among the areas most vulnerable to an OCS related oil spill are the Cape and Islands Ocean Sanctuary of Massachusetts (60%), the coastal wetlands and beach areas located along the western end of the south shore of Long Island (15%), and Martha's Vineyard (22%) and Nantucket Island (28%). In general, oil spills resulting from the transporting of oil to shore as opposed to oil spills from the lease areas pose the greatest risk to sensitive coastal areas.

An estimated 13 oil spills greater than 1,000 barrels each may occur from proposed and existing OCS lease sales (40, 49, and 59) in the adjacent Mid-Atlantic region. Oil spills from this region are not expected to have a significant cumulative impact on marine and coastal habitats impacted by OCS activities in the North Atlantic region (compare Tables 10 and 16, Appendix D). However, the cumulative effect of OCS activities from both regions combined could result in the degradation of several nearshore and coastal areas ranging from Martha's Vineyard to Cape Hatteras, N.C. The impacts to these sensitive habitats will tend to be relatively short-lived due to the natural breakdown of oil in the marine environment and to oil spill containment and clean-up operations required under OCS Operating Order No. 7. Toxic hydrocarbons that might become entrapped in bottom sediments or sink areas could pose a long term (5+ years) threat as oil trapped in sediments degrades very slowly and may be resuspended in the water column when disturbed (Sanders et al, 1980). Oily sediments can have a deleterious effect on marine benthos.

Cumulative impacts from onshore support facilities including gas processing plants, gas pipelines and supply bases should be minimal and short-term as support facilities are expected to be located in existing industrial areas or rights-of-way. Because oil recovered from the proposed lease areas is assumed to back out an equal volume of existing oil imports, a cumulative increase in the number of oil spills that could occur and impact sensitive coastal areas from OCS activities and imported oil combined is not anticipated.

Conclusion: The degradation of some sensitive coastal areas could occur as a result of one or more OCS related oil spills impacting these areas. Both short-term and long-term adverse effects from an oil spill contacting these areas would be expected. Impacts on coastal habitats from OCS support facilities should be minimal.

ALTERNATIVE 2: DELAY THE SALE

To delay the sale may not reduce the risk of an oil spill impacting sensitive coastal areas as imported oil traffic will continue to pose a significant threat to these resources. Potential impacts outlined under the proposal would not necessarily be changed or reduced by a delay of the sale. A delay would allow additional time for implementing a program to monitor the impacts of exploration and development from OCS Sale No. 42. Information from any monitoring programs could aid in determining, quantifying, and mitigating OCS related impacts from proposed Sale 52 and for future offshore lease sales. In addition, a delay would allow more time for NOAA to consider designating discrete areas of the North Atlantic region as marine sanctuaries (Addressed in Section I.B.3). However, the effects of a sanctuary designation on sensitive coastal areas would not be known until the objectives and regulations governing the management of the sanctuary are promulgated.

Conclusion: To delay the sale would postpone impacts to sensitive coastal areas from the proposed Sale 52. If information on Sale No. 42 exploratory activities was gathered during the delay period, it may be useful in assessing impacts from the proposed sale and from future lease sales.

ALTERNATIVE 3: CANCEL THE SALE

To cancel the proposed sale would significantly reduce the probability of an OCS related oil spill occurring and impacting sensitive coastal areas in the North Atlantic region, although the existing lease sale No. 42 would continue to pose a threat to certain areas (Tables 15 and 16, Appendix D.). Sensitive coastal habitats along the south shore of Long Island, Martha's Vineyard, and Nantucket Island would benefit the most under this alternative.

However, the risk of a major oil spill occurring and impacting these resources will remain very high as imported oil will continue to be tankered into the major ports (Table B-1, Appendix D). An estimated 93 oil spills greater than 1000 barrels each could occur over a 30-year period from oil imported into the North and Mid-Atlantic regions combined. A cumulative increase in the number of oil spills that could occur and impact sensitive coastal areas from OCS activities and imported oil traffic combined is not anticipated because oil recovered from OCS lease areas is expected to back out an equal amount of existing oil imports. Therefore cancellation of the sale may not result in a net reduction in the risk of an oil spill impacting sensitive coastal resources in the North and Mid-Atlantic regions.

Conclusion: Cancellation of the proposed sale would significantly reduce the probability of an OCS-related oil spill occurring and impacting sensitive coastal areas in the North Atlantic region. However, these resources would continue to face a high risk of impact from spills of imported oil.

ALTERNATIVE 4: DELETE TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

The impacts to sensitive coastal areas under this alternative should not be significantly different from those described under the proposal. The probabilities of one or more oil spills impacting these resources over the expected life of the field are essentially the same for the proposal and this alternative (See OSTAM Tables 9 and 13, Appendix D). Impacts from onshore support facilities should also be unchanged.

Conclusion: Impacts to sensitive coastal areas under this alternative should be essentially the same as those identified under the proposal.

ALTERNATIVE 5: MODIFY THE PROPOSAL BY DELETING TRACTS TO PROTECT FISHERIES

Under Alternative 5, the probabilities of an oil spill occurring and impacting Massachusetts' Cape and Islands Ocean Sanctuary, national wildlife refuges, and coastal marshes over a 30 year time period are 52%, 16%, and 27% respectively as opposed to 56%, 18%, and 30% under the proposal. Therefore, implementation of alternative 5 would slightly reduce the risk of an oil spill occurring and impacting these sensitive coastal resources. Impacts from onshore OCS related development should be minimal.

Conclusion: The risk of impacting sensitive coastal resources from an OCS related oil spill would be slightly less under alternative 5. Onshore impacts should be minimal.

ALTERNATIVE 6: MODIFY THE PROPOSAL BY DELETING TRACTS IN THE VICINITY OF CANYON HEADS

Impacts to sensitive coastal areas under this alternative should not change from those identified under the proposal due to the small number of tracts that would be deleted (approximately 6% of the proposed sale area) and to their great distance from these coastal areas.

Conclusion: Impacts under this alternative are expected to be the same as those anticipated under the proposal.

ALTERNATIVE 7: A GEORGES BANK MARINE SANCTUARIES

Impacts to sensitive coastal areas under this alternative could be similar to those expected under Alternative 5 but may be even more severe if oil is transported by pipeline to a mooring buoy servicing OCS tankers. The additional subsea pipeline required to handle crude oil recovered from the remaining portions of the lease area could pose an additional oil spill risk thereby increasing the probability of an oil spill occurring and impacting coastal areas.

Conclusion: Implementation of this alternative could result in impacts to sensitive coastal areas that would be very similar to those expected under Alternative 5, but may be even more severe.

ALTERNATIVE 8: MODIFY THE PROPOSAL BY DELETING 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

The probability of an oil spill occurring and contacting sensitive coastal habitats could be moderately reduced under alternative 8 due to the decrease in size (approximately 18%) of the proposed lease area. Impacts from OCS onshore development should not change from those expected under the proposal.

Conclusion: The risk of an oil spill occurring and contacting sensitive coastal habitats could be moderately reduced under this alternative.

6. Impacts on Endangered and Threatened Species and Species of Concern

Pursuant to Section 7 of the Endangered Species Act, formal consultation must take place between BLM, the Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) prior to offshore oil and gas exploration (See Section I.D.5). This process was initiated on April 22, 1981. FWS and NMFS are required to provide BLM with a formal biological opinion within 90 days of the date on which consultation was initiated. The FWS opinion appears in Appendix F.

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Birds and Coastal Species

The bald eagle is an endangered species which could be impacted by an oil spill reaching shore. If an eagle was to contact or ingest oil-contaminated food several impacts could result: the eagle could be poisoned by the oil, it could suffer sublethal physiological abnormalities, egg-laying could be inhibited, plumage could become oiled, or oil could be transferred to eggs thus reducing hatchability. These impacts are considered unlikely unless crude oil or oiled fish or birds wash upon the shore in the eagle's territory. Should an oil spill occur, the probability of it impacting a bald eagle nesting area from the proposed lease area or from a Sale 52 tanker route is less than 0.5% (Table 5, Appendix D).

Endangered peregrine falcons could be impacted during their spring and fall migrations through the North Atlantic region. Peregrines would be most susceptible to oil pollution by preying upon oil impacted sea birds. This could result in direct toxicity to the falcon, oiled plumage, or sublethal physiological disorders. Because peregrines have been found as far as 300 miles offshore, oil spills from the lease area that do not approach shore could affect peregrines by impacting offshore prey species. Currently, an attempt is being made to re-establish breeding peregrines in several coastal areas of New Jersey. Oil spills reaching these breeding areas would not only pose a threat to adult birds but to their eggs and young too since the adults

could transfer oil to their nest. However, should a spill occur the probability is less than 0.5% that an oil spill from the proposed lease area would impact peregrine migratory stop-over or breeding areas. If a Sale 52 tanker spill should occur, the probability of it impacting peregrine falcon migratory stop-over or nesting areas is 4% or less and 1% or less, respectively (Table 5, Appendix D).

The osprey is a species of concern which could be affected by an oil spill. The osprey is a fish eating bird which swoops down and captures fish near the water surface. It is also known to cover its eggs with seaweed to regulate humidity. These two characteristics make it vulnerable to an oil spill by oil ingestion, fouling, or reproductive impairment. Ospreys, however, are rarely found more than five miles from their nests (and generally less than two miles) so the areas of concern for osprey safety are in the immediate vicinity of the nests. The closest concentration of osprey nests to the proposed sale area centers around the eastern end of Long Island and the seaward approaches to Long Island Sound. It is unlikely that osprey nesting areas will be exposed to an oil spill from the lease area. Assuming that a spill has occurred, the probability of it reaching osprey nesting areas is less than 0.5%. If a Sale No. 52 tanker spill should occur, the probability of it impacting osprey nesting areas is 7% or less, depending upon the route used (Table 5, Appendix D).

The combined effect of oil spills from the proposed lease area and from Sale 52 tankers can result in an increased risk of impact to peregrine falcon migratory stop-over areas and osprey nesting areas. The probabilities of an oil spill occurring and impacting these areas from all sale related activities over a 30 year period are 11% and 24% respectively (Table 9, Appendix D). These probabilities suggest a moderate risk that one or more Sale No. 52 related oil spills may impact these areas. This may result in the mortalities of some individual birds but should not pose a serious threat to each population as a whole.

The endangered eskimo curlew would utilize coastal areas during its migrations through the North Atlantic region and would be exposed to the same types of impacts as other shorebirds (See Section IV.C.7). Since the curlew has not been sighted for many years in the area and is currently thought to be extirpated from the Eastern United States, one must consider the probability of impact to be insignificant.

The shortnose sturgeon is an endangered anadromous fish which spawns in the mid and upper portions of the Connecticut, Hudson, and Delaware Rivers. It is extremely unlikely that an oil spill or any sale related activities will adversely affect the shortnose sturgeon because of the downstream and coastal location of support facilities and the low probability (less than 1%) of an oil spill, should one occur from the lease area or from a Sale No. 52 tanker route, entering either the Connecticut, Hudson, or Delaware Rivers. Since

so little is known about the life history of this fish when it enters salt water, it is difficult to assess impacts to this species when it exists in its marine environment. The threat of a serious adverse impact would seem remote due to the demersal habits of this species.

Conclusion: Federally listed, coastal oriented endangered species and species of concern are not likely to be impacted by an oil spill originating from either the lease area or from a Sale 52 tanker accident alone. However, the combined effect of Sale 52 related oil spills could pose a moderate risk to peregrine falcon migratory stop-over areas and osprey nesting areas. Onshore development should not threaten the coastal areas utilized by these species.

Turtles

The effects of oil on sea turtles have not been well documented in the literature. However, it is reasonable to assume several types of adverse impacts based on sea turtle behavior. Turtles are air breathers and therefore must periodically surface to breathe. If turtles surface in an oil slick, they could become fouled with oil and suffocate. This would be especially true of small, young turtles. It has been suggested that sea turtles are actually attracted to oil spills (Witham, 1978). However, there is no conclusive evidence to support this potentially harmful trait.

Another way sea turtles may be affected by an oil spill is through their diet. Dead turtles have been found with tar balls in their gut. The effect of oil ingestion on turtles is not known; however, it must be considered detrimental. Since a total of 10 spills greater than 1,000 barrels each are estimated to occur over the production life of the field (approximately 30 years), all sea turtles in the region may face a relatively high risk of contacting one or mor of these spills.

It is generally accepted that offshore platforms act as artificial reefs causing a large increase in biomass in their immediate vicinity. Such an increase will probably attract feeding turtles. Twenty production platforms are expected to be used to develop the field under this alternative. While initially this appears to benefit turtles, certain adverse impacts may occur which could outweigh the benefit. If an oil spill occurs at a platform, turtles would be in close proximity to it and would be more likely to be adversely impacted. Furthermore, if members of the biological communities under the platforms accumulate the toxic materials and trace metals routinely discharged from the platform, the turtles can, through the food chain, ingest the toxins with the probable results being physiological disorders or death.

Sea turtles can be killed or injured by collisions with ships. Increased ship traffic due to service vessels (a peak of 87 by 1995) will increase the risk of turtles colliding with ships. If platforms attract turtles as expected, the increase in vessel traffic will occur in areas where turtles may congregate.

The three endangered species of sea turtles in the North Atlantic region include the hawksbill, the leatherback, and the Atlantic ridley. The two threatened species are the loggerhead and the green sea turtle. Of all the endangered or threatened sea turtles only the loggerhead and leatherback occur in the proposed lease area or in Sale No. 52 tanker routes in relatively high numbers. The hawksbill is only an accidental visitor to the North Atlantic region, this species is not expected to be impacted by OCS oil development. The leatherback could be adversely impacted by sale related activities and oil spills from the lease area in early summer and late fall when the majority of turtles are believed to migrate directly through the proposed lease sale area.

For the remainder of the year, the leatherback would be concentrated north of the Sale area during the summer and far to the south during the winter. The Atlantic ridley prefers shallow coastal waters and is present there from spring through fall. The threat of a serious impact to this species from Sale No. 52 related activities is very remote due to the distance from shore of the proposed sale area (86 to 164 statute miles), the fact that this species is a bottom feeder which reduces the opportunities for contacting spilled oil or for ship collisions, and that the North Atlantic region represents the northern extent of this animal's range. However, sighting and strandings in the waters around Cape Cod are not uncommon.

The loggerhead would be vulnerable to sale area related impacts in late summer and early fall when migrating individuals reach the waters of the proposed lease area. Impacts to this species are not expected to be severe due to the tendency for these turtles to be concentrated in shallow shelf waters south of Long Island, New York (Mid-Atlantic). Assuming that a spill has occurred in the proposed lease area, the probability of it entering the waters where the loggerhead is concentrated is less than 0.5%. However, OCS tanker traffic from the proposed sale is expected to transit the Mid-Atlantic region. Should a Sale No. 52 tanker spill occur in this region, the probability of impacting the turtles at sea would increase. Some mortalities could occur, but the impact to the whole population should not result in a serious adverse effect.

In addition to the several types of impacts noted above, the loggerhead sea turtle could be adversely impacted by oil washing ashore on its nesting beaches. The probability of a spill that has originated from the proposed lease area or from a Sale No. 52 tanker accident, impacting a loggerhead nesting beach is less than 0.5%. These very low probabilities indicate that any oil spills resulting from the proposed sale would not pose a serious threat to loggerhead nesting beaches.

Green sea turtles would be vulnerable to oil spill related impacts during the spring, summer, and fall seasons. Because of their infrequent occurrence in the region, they are not expected to incur significant adverse impacts from the proposed sale.

Conclusion: A small number of turtle mortalities could result from sale related activities and the high number (10) of estimated oil spills. This should not pose a serious threat to each population. The hawksbill, green, and ridley turtles should not be exposed to any significant adverse impacts due to their infrequent occurrence in the region.

Marine Mammals

The potential impacts from offshore oil development on marine mammals are inconclusive and speculative. To date, there have been only two experimental studies on the effects of oil contact on pinnipeds (seals) and sea otters, and one on the effects of oil ingestion on pinnipeds (Geraci and St. Aubin, 1979). No studies have yet been completed on cetaceans. However, a major study funded by the BLM is expected to provide more conclusive information on the effects of oil on cetaceans by March, 1982.

Pinnipeds: The harbor and gray seals are not endangered or threatened but are species of concern. They could be vulnerable to several adverse effects should they come in direct contact with an oil spill. They may inhale or ingest oil or become fouled with oil when swimming or feeding. This could inhibit bodily functions or may even cause death. Oil can also irritate the eyes of a seal. In the case of the gray seal, oil could wash ashore on its only known breeding grounds in U.S. waters (i.e. Muskeget Island, Massachusetts) and pose a threat to any pups in the vicinity. Low flying helicopters servicing the lease area from the existing airfield at Hyannis, Massachusetts, should they fly over Muskeget Island, could startle breeding gray seals Minimum altitude requirements for this island and its surrounding waters may be needed to prevent a serious impact to breeding gray seals. Assuming that a spill has occurred in the proposed lease area, the probability of it impacting Muskeget Island within 30 days is less than 0.5%. The probability of a Sale 52 tanker spill impacting Muskeget island within the same time frame is 8% or less depending upon the route (Table 5, Appendix D). The cumulative probability of an oil spill occurring and impacting Muskeget Island from all Sale 52 related activities over a 30 year period is 18% (Table 9, Appendix D). These probabilities indicate that a tanker spill could pose a greater risk to the seals that a spill from the proposed lease area. The cumulative probability suggests a moderate risk of impact which could lead to a long-term adverse effect on the Muskeget Island gray seal colony due to its small size (10-15 individuals).

Adverse impacts from sounds produced during seismic exploration or from collisions with or disturbance from service vessel traffic are not anticipated due to the great distance between the lease area and the waters around Muskeget Island and to the unlikelihood of service vessels transiting island waters.

Cetaceans: Whales could be vulnerable to several adverse effects should they come in direct contact with an oil spill. These effects include skin

and eye irritation, inhalation or ingestion of oil, and baleen fouling. Exploration and drilling related sounds and activities may also have an effect on whales.

Because the epidermis of the skin of all cetaceans is composed of viable (live) cells, it has been assumed that cetaceans may be particularly vulnerable to the noxious effects of direct contact with spilled oil (Geraci and St. Aubin, 1980). In addition, cetaceans would also be susceptible to eye problems similar to those recorded for seals. However, cetaceans have been observed in the vicinity of major oil spills (Santa Barbara, Argo Merchant, and Regal Sword oil spills) without showing any obvious signs of distress or noticeable increase in mortality (Grose and Mattson, 1977; Orr, 1969; Goodale, Hyman and Winn, 1981). Because cetacean skin is smooth and essentially hairless, the risk of an animal becoming coated with oil is extremely remote. It has been suggested that cetaceans may inhale oil through their blow holes should they surface in an oil slick. This seems unlikely as the typical breathing cycle of cetaceans involves an explosive exhalation followed by an immediate inspiration and abrupt closure of the blowhole. This mechanism has evolved to prevent inhalation of water and would be as discriminatory of oil (Geraci and St. Aubin, 1980).

Ingestion of oil may pose a problem to cetaceans because it is not known whether they can detect and avoid oil, particularly when feeding. If oil were ingested, the effects on these animals would probably be dependent upon the amount and toxicity of the oil, duration of exposure, and physical condition of the individual. Filter feeders, such as the baleen whales, could be susceptible to baleen fouling. This could lead to severe problems by inhibiting an individual's ability to feed. All of the endangered whales in the North Atlantic region with the exception of the sperm whale, are baleen whales. If a large spill should occur, it could temporarily contaminate and/or reduce the food supply in the vicinity of the spill. Whales feeding in the area could either ingest oil by eating the contaminated prey or be forced to search for supplemental food sources beyond the vicinity of the spill. Since a total of 10 oil spills greater than 1,000 barrels each are estimated to occur over the production life of the field (approximately 30 years), all six of the endangered whale species occurring in the region may have a relatively high risk of contacting one or more of these spills.

Offshore oil exploration will cause an increase in ship traffic. The total number of crew boats, supply boats, and tug boats servicing the rigs is expected to range from 8 boats in 1984 to 87 in 1995 and then decline. The increase in ship traffic may increase the probability of having collisions with cetaceans. The actual number of collisions would probably have an insignificant effect on most populations.

Fraker (1977) found that tugboat and barge traffic that passed through an area containing numerous white whales evoked a distinct avoidance response from almost all whales within an estimated 1.5 miles of the vessels. Both the uniformity and the distance of the reaction suggested that the whales

were responding to vessel sounds. Additional observations indicated that moving sound sources may be more disturbing to whales than stationary sources. The response of cetaceans to low frequency sounds of the type which are likely to emanate from exploration and production platforms are unknown. In order to better assess the impact of sounds from offshore oil and gas structures on cetaceans, the BLM has contracted with the Naval Ocean Systems Center in San Diego, California to study this potential problem. Results from this work are anticipated by October 1981.

The six endangered species of whales occurring in the North Atlantic region are described in Section III.B.1.d. Four of the six species appear to transit the sale area mainly during migration periods with more critical activities (e.g. breeding and feeding) being conducted beyond the sale area. Only the sperm whale is known to concentrate its feeding activities within the sale area. They could be subjected to the same potential impacts which were discussed above, but because of their endangered status, any impact which does occur might have more serious consequences. The right whale is considered to be the most endangered marine mammal in the region. Any adverse impacts to right whales could have an especially damaging effect on their small population.

Fin whales could be exposed to OCS related impacts all year-round as this species was recorded in the North Atlantic region throughout the year in 1979 (Hain et al., 1981). However, actively feeding adults and adults with calves are concentrated in the waters around Cape Cod, Massachusetts and the upper portion of the Great South Channel (See Visual No. 2) from May through September. Assuming that an oil spill has ocurred in the proposed lease area or along a Sale 52 tanker route, the probability of it reaching these feeding areas is less than 1% and 2%, respectively, indicating a minimal risk of imapct to these animals when they are on these feeding grounds.

The sei whale generally prefers deeper shelf and slope waters. The tendency for this species to feed at the waters surface could make it particularly vulnerable to an oil spill. However, only seven sightings of sei whales were recorded in the Mid and North Atlantic regions including the proposed lease area during 1979 (Hain et. al, 1981). The majority of the population may have been in much deeper waters (over 2,000m) or further north around Nova Scotia and Newfoundland. If further field data support the findings of 1979 which indicate that relatively few sei whales utilize the sale area, then the risk of a serious impact occurring to these whales would be very unlikely.

Sperm whales can be encountered most frequently in the proposed lease area along the 1000m contour the year-round with highest numbers occurring from spring through fall (Hain et al., 1981). In addition, sperm whales enter shallow shelf waters (along the 70m contour) restricted to the area south of Block Island to southeast of Nantucket Island during the fall season, apparently to feed on migrating squid. Since sperm whales are active within

the lease area, they will be vulnerable to OCS related impacts. Sperm whales are bottom feeders and would be less likely to encounter an oil spill on the surface. However, the physical presence of the drill rigs and the sounds they produce may inhibit normal activities. Sale 52 tankers are expected to pass directly through the shallow shelf waters used by the sperm whale in the fall. Tanker accidents in the area could have a greater risk of contacting these whales during the fall when they concentrate and feed in these waters.

Humpback whales were observed throughout the North Atlantic region the year round; however, they concentrate in the waters around Cape Cod and Cape Ann, Massachusetts and the upper portions of the Great South Channel from May through October. Feeding activity and adults with calves were observed frequently in these areas. Humpbacks were also recorded within the boundaries of the proposed lease sale area, more often in the northern sections. Due to the low probability of an oil spill from the lease area or from an OCS tanker route reaching humpback areas of concentration (less than 1.0% and 2.0%, respectively), sale related activities pose a minimal risk to the whales in these areas. Since it appears that these whales do not congregate or feed to any great extent in the proposed lease area or in expected Sale 52 tanker routes, the risk of an adverse impact occurring in these waters is diminished.

The right whale tends to concentrate in the same general areas as the humpback and is seen with some regularity in all seasons of the year northward of 40½ 30' N. Feeding activity was observed in these areas during May and June. Breeding activity has been observed by Kraus and Prescott (1981) in the entrance to the Bay of Fundy which borders the northern boundary of the Gulf of Maine. The probability of a spill from the lease area or from a Sale 52 tanker route reaching these areas is very low, making a serious impact unlikely. However, due to the surface feeding behavior of this species and to the critically low numbers of right whales (about 100-150), contact with an oil spill or any other adverse impact could have an especially serious effect on this population.

The blue whale has been drastically reduced from its former numbers and is now rarely seen in U.S. waters. They ocassionally stray into the Gulf of Maine, but are generally found in the Gulf of St. Lawrence and more northern waters. Therefore, it is highly unlikely that the blue whale will be impacted by any Sale 52 related activities.

The migration routes of the endangered whales are poorly understood. However, results from the first year's effort of the Cetacean and Turtle Assessment Program (CETAP) suggest that the fin, sperm, humpback, and right whales migrate north through the proposed lease area during late winter to early spring by way of the Great South Channel (fin, humpback, and right only) and possibly along the southeastern edge of Georges Bank. The reciprocal fall migration occurs essentially in reverse from late fall to early winter. When these migrating whales pass through the proposed lease area, they would be

vulnerable to Sale 52 related impacts. However, these whales would be constantly on the move and they appear to feed very little or not at all when migrating. Consequently, the type and amount of exposure they would have to Sale 52 related impacts would be limited. Because the whales migrate on a relatively broad front, the physical presence of the rigs and the sounds they produce together with Sale 52 tanker traffic should not have a concentrated effect on the animals. However, the long term effects may lead these whales to alter their migration routes. If the whales use the Gulf Stream to migrate northward, as has been suggested, oil spills entering the Gulf Stream could impact migrating whales. However, oil spills from the lease area would tend to enter the Gulf Stream southeast of the proposed sale area, beyond the suspected migration routes (Tables 5 and 9, Appendix D).

Conclusion: Gray seals on Muskeget Island face a moderate risk of being contacted by one or more oil spills over a 30 year period. This could lead to a long-term adverse effect on this seal colony due to its small size (10-15 individuals). The impacts on cetaceans from the proposed sale are uncertain. However, a serious impact to the sperm whale population from Sale 52 activities is not likely.

CUMULATIVE IMPACTS

Birds and Coastal Species

Considering the cumulative impacts of the proposed No. Sale 52 and the existing OCS sale No. 42 in the North Atlantic, region a total of 11 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of these sales. Their combined probabilities of an oil spill occurring and impacting endangered and threatened species and species of concern over a 30-year period from these sales are listed in Table 9, Appendix D. Peregrine falcon migratory stop-over areas (13%) and osprey nesting areas (26%) have the highest probabilities of being contacted by a spill. Bald eagle and shortnose sturgeon areas have less than 0.5% chance of being impacted by a spill during the same period. These probabilities suggest that OCS activities in the North Atlantic region could pose a moderate threat of impact to peregrine migratory stop-over areas and osprey nesting areas and only a minor threat to the remaining coastal species.

An estimated 13 oil spills greater than 1,000 barrels each may occur from proposed and existing OCS lease sales (40, 49, and 59) in the adjacent Mid-Atlantic region. Oil spills in the Mid-Atlantic region are not expected to have a significant cumulative impact on the coastal habitats utilized by these species in the North Atlantic region (compare Tabke 10 and 16, Appendix D). However, due to the migratory behavior of the bald eagle and peregrine falcon, these birds could come in contact with one or more of the estimated spills in the Mid-Atlantic region.

In addition to impacts from sales in the North and Mid-Atlantic regions, migratory peregrine falcons could even be affected by OCS sales in the South Atlantic. The cumulative effect from all OCS sales in the Atlantic

could result in a small number of birds becoming fouled with oil. It is unlikely that this should have a significant adverse impact on the population as a whole, but may result in the mortality of some individual birds.

Impacts that are not related to OCS activities but could contribute to a cumulative impact to all coastal species would include the loss of onshore breeding, migratory stop-over, and over-wintering habitats from private and recreational development of coastal areas. The Arctic peregrine falcon migrates through Central and South America where it is exposed to toxic pesticides like DDT which can drastically reduce the reproductive capabilities of these birds. The net effect of these impacts could inhibit the return of each species to a non-endangered status or further reduce remaining populations.

Turtles

Cumulative impacts to endangered and threatened sea turtles can not be accurately predicted. However, since all of the species have been known to occur in the three OCS lease areas bordering the Atlantic coast, sea turtles could be impacted by oil and gas related activities over a major part of their range. The high number of estimated spills (11, 13, and 3 spills in the North, Mid-, and South Atlantic regions, respectively) together with other OCS activities will probably result in some turtle mortalities, particularly for leatherbacks and loggerheads as they are the more prevalent species.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact to sea turtles include moderate to high mortality rates caused by commercial fishermen in the Gulf of Mexico and along the southeastern coast of the U.S., and natural and man-induced predation of turtles and eggs on nesting beaches of all five species in the Gulf of Mexico/Carribbean Sea region. The cumulative effect of these impacts could result in additional mortalities and possibly population declines for all species. This would be especially detrimental to leatherback, hawksbill, and ridley sea turtles due to their low population sizes.

Marine Mammals

Cumulative impacts from all OCS activities in the North Atlantic region are not expected to adversely effect seals with the possible exception of the gray seals on Muskeget Island, Mass. There is a moderate risk (19%) of this island being impacted by an oil spill from the proposed Sale No. 52 and existing Sale No. 42 combined over a 30 year production period. Helicopter traffic in the vicinity of the island may need to be regulated to prevent seals from abandoning the island.

Cumulative impacts to endangered whales from OCS activities are uncertain as the fin, sei, sperm, humpback, and right whales are known to occur to some degree in all three OCS lease areas bordering the Atlantic coast.

The blue whale may be impacted by sales in the Mid- and North Atlantic. The high number of estimated spills (11, 13, and 3 spills in the North, Mid-, and South Atlantic regions respectively) together with other OCS activities will probably result in some adverse impacts including the possible loss of a few whales which could inhibit the return of each species to a non-endangered status.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact to humpback whales include the annual subsistence level fisheries for this species in Greenland (International Whaling Commission (IWC) quota of 10 in 1981) and Bequia, British West Indies (2 or 3 per year). Entrapment injury and mortality (17 killed in 1980) from inshore fishing gear along the Newfoundland coast is also a problem (Humpback Whales of the Western North Atlantic Workshop - New England Aquarium, Boston, MA. November 17-21, 1980). The IWC set a quota of 130 sperm whales for the entire North Atlantic including European and African waters during the 1980/81 season. The fin whale stock that is believed to transit OCS sale areas (the Nova Scotia stock) is not hunted, but members of an adjacent stock, the Newfoundland-Laborador stock, are hunted (IWC quota of 90 for 1980/81 season and probably mix with the Nova Scotia stock. Sei whales are not hunted in the Western North Atlantic and the blue and right whales are fully protected by the IWC from hunting. Canadian offshore oil drilling in the waters around Nova Scotia and Newfoundland could also impact each endangered whale. The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters. The cumulative effect of OCS activities and activities unrelated to OCS operations could result in a low number of additional whale mortalities which could inhibit the return of these animals to a non-endangered status.

Conclusion: The cumulative effect of proposed Sale 52 and all existing OCS sales in the North, Mid-, and South Atlantic regions combined could result in the mortality of some individual birds. It is unlikely that this should have a significant adverse effect on the population as a whole. Cumulative impacts to endangered marine mammals and sea turtles from all OCS activities are uncertain but may result in the possible loss of a few individuals. The loss of a few individuals could reduce already depleted populations or inhibit the return of each species to a non-endangered status. Impacts unrelated to OCS activities will result in some marine mammal and sea turtle mortalities. The net effect could have a long-term adverse impact on their remaining populations.

Alternative 2: Delay the Sale

Birds and Coastal species

To delay the sale would postpone, not avoid or reduce the risk of impact to these species. However, additional information may be gathered during the delay period that could be used to mitigate adverse impacts. A delay of several years might allow the population size of each species to increase making them less vulnerable to serious long term impacts.

Turtles and Marine Mammals

The effect of a delay of sale on turtles and marine mammals would result in postponing, not avoiding or reducing impacts to these species. To delay the sale until more information is available on these species may not be necessary as the results of the CETAP study will provide information on population size, distribution, and habitat characteristics in relation to the proposed lease area prior to exploratory drilling. Major studies pertaining to oil and sound effects on cetaceans will also be available by then. Should any major new impacts be identified as a result of these studies, biological Stipulation No. 2 could be invoked to mitigate or prevent the impacts. A delay of several years might allow the population size of each species to increase making them less vulnerable to serious long term impacts.

In addition, a delay would allow time for NOAA to consider designating discrete areas of the North Atlantic region as marine sanctuaries (addressed in Section I.D.3). However, the effects of a sanctuary designation on endangered species would not be known until the objectives and regulations governing the management of the sanctuary are promulgated.

Conclusion: To delay the sale would not necessarily benefit any endangered species as sale related impacts would be postponed not avoided or reduced. A delay of several years might allow endangered populations to better resist serious long term impacts. Certain discrete areas could be designated as marine sanctuaries, but the effects of such a designation would depend upon the objectives and regulations required to manage the sanctuaries.

Alternative 3: Cancel the Sale

Birds and coastal species

To cancel the sale would significantly reduce the probability of an oil spill occurring and impacting coastally-oriented endangered species from OCS oil and gas activities in the North Atlantic region. However, oil and gas exploration will be ongoing from Sale No. 42 and from Sales in the Mid-Atlantic region and will pose some risk to these species (OSTAM Table 15, Appendix D.). Osprey and peregrine falcons are the only species that would

significantly benefit from a cancellation of the sale as they face a moderate threat from the proposed sale. The risk of a major oil spill occurring in the North and Mid-Atlantic regions combined will remain very high as tankers transporting imported oil will continue to service the East coast. OSTAM predicts that an estimated 93 oil spills greater than 1,000 barrels each may occur in the North and Mid-Atlantic regions combined over a 30-year period due to oil imports.

Turtles

If the sale is cancelled, impacts from OCS oil and gas exploration in the North Atlantic region would be greatly diminished. Any turtle mortalities from OCS oil spills and related impacts in the North Atlantic region would be minimal or nonexistent, but some may occur in the Mid- and South Atlantic regions. However, the potential for serious impacts to sea turtles would probably remain high as a result of non-OCS related oil spills and from accidential deaths incurred from the fishing industry.

Marine Mammals

To cancel the sale would significantly reduce the risk to marine mammals of being adversely impacted by OCS-related activities in the North Atlantic region. This would be of particular benefit to the right whale due to its very low numbers and to the sperm whale which tends to congregate in the lease area along the 1000m contour. However, OCS activities in the Mid- and South Atlantic regions will continue to impact migrating marine mammals. The high number of estimated oil spills from existing oil imports will continue to pose a serious threat to all marine mammals occurring in the area.

Conclusion: Cancellation of the sale may not significantly reduce the risk of an oil spill impacting endangered species, particularly for whales and sea turtles. OCS related impacts in the North Atlantic region would be greatly reduced, but non-OCS related impacts would continue to pose an important threat to these species.

Alternative 4: Delete Tracts In Water Depths Greater Than 2000 Meters

Birds and Coastal Species

The impacts to endangered birds and coastal species under this alternative should not be significantly different from those described under the proposal. The probabilities of one or more oil spills impacting these species over the expected life of the field are the same for Alternatives 1 and 4. Impacts from onshore production and development and support facilities should also be unchanged.

Turtles

Under alternative No. 4, impacts to sea turtles from oil spills could be reduced (10 estimated spills under the proposal versus 9 estimated spills under Alternative No. 4). However, impacts from OCS ship traffic or from drilling activities and rig discharges should not be significantly reduced for any species.

Marine Mammals

Under Alternative 4, impacts to marine mammals from oil spills would decline due to the fewer estimated oil spills. Impacts from OCS ship traffic and exploration and drilling sounds should not be significantly reduced for any species with the possible exception of the sperm whale. The sperm whale is the most abundant species in deep waters and could benefit from a reduction in OCS activities in their deep water habitat. However, no major change in impacts to the sperm whale should be expected under this alternative due to the small amount of the proposed lease area (approximately 9%) that would actually be deleted.

Conclusion

Implementation of Alternative 4 may reduce the risk of an oil spill impacting endangered species,particularly marine species. However, the overall effects of the Sale should not be significantly different from those described under the proposal.

Alternative 5: Modify the Proposal by Deleting Tracts to Protect Fisheries

Birds and Coastal Species

Under Alternative 5, the probabilities of an oil spill occurring and impacting peregrine falcon nesting areas, migratory stop-over areas, and osprey nesting areas over a 30-year time period are 2%, 10%, and 22%, respectively, as opposed to 2%, 11%, and 24% for the proposal. Therefore, implementation of Alternative 5 would slightly reduce the risk of an oil spill impacting the important habitats of these species. Impacts from OCS-related onshore development should remain negligible.

Turtles

Implementation of Alternative 5 could significantly reduce the risk of OCS activities impacting sea turtles because all five species tend to feed and concentrate in water depths less than 200 m. Impacts from drilling rigs and service vessels could also decline. The risk of sea turtles contacting an oil spill would be less, as only 8 oil spills greater than 1,000 barrels each are estimated to occur over a 30-year period under this alternative versus 10 spills under the proposal. However, the loggerhead and the leatherback would still transit the remaining lease tracts and would be susceptible to impacts during these times.

Marine Mammals

Impacts to all marine mammals should be less under Alternative 5 because the blocks that would be deleted are the closest ones to shore (reduces the risk of impacting seals) and to the Great South Channel area (whale feeding grounds). The probability of an oil spill impacting humpback and right whale feeding areas or migrating whales in general would decline as fewer oil spills over 1,000 barrels each are projected under this alternative (8 versus 10 under Alternative 1). Impacts from service vessel traffic or drilling operations should be moderately reduced. The sperm whale and possibly the sei whale would remain vulnerable to most OCS related impacts as these two species occur most often in deeper waters, including the remaining lease tracts.

Conclusion

Implementation of Alternative 5 would tend to reduce the probability of an oil spill impacting any endangered species or their habitat. Impacts from service vessel traffic and drilling operations should also be moderately reduced. Impacts to sea turtles and whales, except for the sperm and sei, could be moderately reduced.

Alternative 6: Modify the Proposal by Deleting Tracts In the Vicinity of Canyon Heads

Birds and Coastal Species

The deletion of tracts around the heads of the major canyons should not change the type or degree of impact to these endangered species due to the low number of tracts that would be deleted (approximately 6% of the proposed sale area) and to their distance from shore (greater than 80 statute miles).

Turtles and Marine Mammals

Impacts to sea turtles and marine mammals under this Alternative should be essentially unchanged from those identified under the proposal because neither sea turtles nor marine mammals (whales) have been shown to concentrate in the vicinity of the major canyon heads. Also, the total number of tracts that would be deleted is very small in comparison to the remaining number of tracts.

Conclusion

Impacts to all endangered species and their habitats under this Alternative would be essentially the same as those described under the proposal.

Alternative 7: Consideration of Marine Sanctuaries

The Georges Bank

Impacts to all endangered species under a Georges Bank Sanctuary would be very similar to those expected under Alternative 5 and could be even less severe if oil is transported to shore by pipelines instead of by tankers as pipeline spills are considered less likely to occur than tanker spills. Any reduction in the number of oil spill would be especially beneficial to sea turtles and whales.

Conclusion: Implementation of a Georges Bank Sanctuary could result in impacts to all endangered species that would be very similar to those expected under Alternative 5 and may be even less severe.

Alternative 8: Modify the Proposal by Deleting 94 Tracts Containing Possible Sediment Slumps

Birds and Coastal Species

The probability of an oil spill impacting endangered birds and coastal species could be moderately reduced under Alternative 8 due to the decrease in size (approximately 18%) of the proposed lease area. Impacts from OCS onshore development would be negligible.

Turtles and Marine Mammals

The probability of an oil spill impacting sea turtles or any marine mammals would be less under this Alternative than under the proposal due to the reduced size of the proposed lease area. Because the tracts that are proposed for deletion are in relatively deep water, impacts from service vessel traffic and from drilling activities should not change significantly for sea turtles but may be lessened for sperm and sei whales.

Conclusion: Under this Alternative, the probability of an oil spill impacting any endangered species could be moderately reduced, particularly for sea turtles and whales. However, other sale related impacts to most species are not expected to be significantly changed. Impacts to the sperm and sei whales may be lessened.

7. Impacts on Birds

Alternative 1: The Proposal

Birds, in general, could be exposed to several adverse or lethal impacts from OCS oil and gas exploration and development associated with proposed Sale No. 52. These impacts can be broken down into direct and indirect effects. Direct effects are caused by actual contact with a spill and they include matting of plumage which can reduce flying and swimming ability, loss of buoyancy which prevents resting and sleeping on the water, and loss of insulation resulting in death by exhaustion. It is thought that some species are actually attracted to oil slicks because they appear as calm water areas or suggest concentrations of prey species. Indirect effects are incurred at some time after being exposed to oil. In general, they include oil ingestion and accumulation of toxic petroleum hydrocarbons. This can lead to reproductive failure and increased physiological stress which can reduce an animals ability to survive. (Biderman and Drury, 1980).

Pelagic birds are more abundant over a yearly basis on Georges Bank than in any other area of the North Atlantic region (Powers, Pittman and Fitch, 1980). Assuming that a spill has occurred, the probability of this spill reaching the Georges Bank crest area within 30 days from the proposed lease area or from Sale No. 52 tanker routes ranges from less than 0.5% to greater than 99.5% (Table 5, Appendix D). Since severe losses in numbers of birds are known to result when large spills impact dense concentrations of sea birds (Ohlendorf et al., 1978), an oil spill from the proposed sale could cause significant losses to pelagic birds on Georges Bank.

Pelagic birds in the Gulf of Maine are less vulnerable due to their distance from the lease area and to the anticipated absence of Sale No. 52 tankers and service vessels in these waters. Birds in the waters off Long Island, Martha's Vineyard, and Nantucket Island could be exposed to spills from the proposed lease area and from Sale No. 52 tankers bound for Raritan Bay. The relatively low numbers of birds in these waters would tend to reduce the severity of OCS impacts; however, some mortalities would occur from spills in the area.

Diving species and species that spend much of their time on the water's surface (e.g. murres, puffins, and cormorants) have a much greater risk of contacting oil. Because populations of these birds are very slow to replace lost numbers

due to their low reproduction rates, oil spill mortalities could result in both short- and long-term adverse effects. An oil spill resulting from the proposed sale would pose a minimal risk (less than 0.5% probability of impact) to the dense breeding colonies of numerous sea birds along the Maine coast; but breeding colonies on Nantucket Island, Martha's Vineyard, and the south shore of Long Island face a greater risk of impact from sale-related spills. Assuming a spill has occurred, the probability of this spill impacting these areas from the proposed lease area is 1.0% or less but increases to 12.0% or less from Sale 52 tanker routes (Table 8, Appendix D).

Small chronic discharges of crude oil associated with the discharge of formation waters from production platforms can be more damaging to pelagic bird populations than a single major spill in many cases. Based upon the resource estimates in Section II.A, permissible discharge levels stated in Section IV.A.3, and the assumptions used in the Final Supplement to Environmental Statement, OCS Sale No. 42, p. 155., chronic discharges of crude oil from production platforms could range from 3,802 barrels per year during the first year of production, peak at 7,028 barrels per year and then decline. A total of 83,040 barrels of crude oil could be chronically discharged over the production life of the proposed Sale. However, considering the size of the proposed lease area (approximately 3.1 million acres), the assumed production life of the field (approximately 30 year), and the estimated number of production platforms (20); the daily discharge rate should not pose a serious threat to pelagic species. Yet, some long-term adverse effects such as bioaccumulation of toxic petroleum by-products may occur.

Waterfowl would be particularly vulnerable to oil spill impacts during their spring and fall migrations through the North Atlantic region. The most susceptible waterfowl are the sea ducks which migrate and winter off the coast, especially around the Nantucket Shoals and Sound and the entrance to Long Island Sound. These birds are known to suffer severe losses in numbers from large nearshore spills and from smaller chronic spills (Ohlendorf et al., 1978). A spill occurring in the proposed lease area would pose a minimal threat to these birds (5.0% or less probability of impact), but a Sale No. 52 tanker spill could pose a significant threat to these same birds depending upon the route used (25% or less probability of impact). In addition, support vessel and helicopter traffic could disrupt normal bird activities, but should not have a serious adverse effect.

Wading birds and shorebirds are usually found in shallow marine, estuarine, and salt marsh habitats with their breeding colonies generally associated with these same habitats. Certain coastal areas are particularly important to these birds. Erwin (1979) identified over 4,000 pairs of nesting wading birds on Long Island in 1977. Cape May County, N.J., is one of the most important zones in the western hemisphere for migratory shorebirds with peak spring numbers occurring from April 10 - May 30 (Harrington and Leddy, 1980,

Manomet Bird Observatory, MA, unpublished data). The reciprocal fall migration also utilizes the county to a great extent. A spill occurring in the proposed lease area could pose a minimal threat (1% or less probability of impact) to wading birds and shorebirds, but a Sale No. 52 tanker spill could pose a significant threat to these birds (21% or less probability of impact), particularly along the south shore of Long Island and in the coastal areas of Cape May County. Service vessel and helicopter traffic, and onshore support facilities are not expected to impact wading birds or shorebirds because no significant filling of wetland or coastal habitats to accommodate ports handling OCS service vessels, or industrial sites suitable for gas processing plants.

A number of coastal parks and wildlife refuges exist in the North Atlantic region that are important to marine birds and to a wide variety of wildlife in general. It is highly unlikely (less than 0.5% probability) that an oil spill occurring in the lease area will pose a threat to these parks or refuges. However, Sale No. 52 tankers entering the Raritan and Delaware Bays would pose a moderate threat (17% or less probability of impact) to the parks and refuges bordering the entrances to these bays should a tanker spill occur. Oil spill containment and clean-up equipment will be available to reduce or prevent losses to birds and their habitats (see Section II.B.1.d), but some losses should be expected if a spill occurs and reaches the shore.

The combined effect of oil spills from the proposed lease area and from Sale No. 52 tankers could result in an increased risk of impact to avian resources. A total of 10 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of the proposed lease area. The probabilities of oil spills occurring and impacting avian resources from all sale-related activities over a 30 year period are listed in Tables 9 and 10, Appendix D. Among the most vulnerable targets to Sale No. 52-related oil spills include pelagic birds in the Georges Bank crest area (75%), sea ducks wintering areas (64%), and coastal waterbird colonies (51%). In general, oil spills from Sale No. 52 tankers bound for Raritan Bay as opposed to oil spills from the proposed lease area pose the greater risk to waterfowl and shorebirds. Pelagic species would be highly vulnerable to both tanker and lease area spills.

Conclusion

The relatively high estimated number of Sale 52-related oil spills (10) combined with the moderate to high probability of impact to important habitat areas could result in large losses of marine birds, particularly for pelagic birds and sea ducks. The long-term effect could be population reductions for most species. Important coastal habitats on Nantucket Island, Martha's Vineyard, and the south shore of Long Island would be vulnerable to oil spills resulting from Sale No. 52 tankers bound for Raritan Bay. Small chronic discharges of crude oil contained in formation waters may pose an additional long-term threat to pelagic species.

Cumulative Impacts

Considering the cumulative impacts of the proposed Sale and existing OCS Sale No. 42 in the North Atlantic region, a total of 11 spills greater than 1,000 barrels each may occur over the production life (approximately 30 years) of these sales. The combined probabilities of an OCS oil spill from existing sale no. 42 and the proposed Sale occurring and impacting avian resources over a 30 year period are listed in Table 9, Appendix D. Pelagic birds in the Georges Bank crest area (82%), sea duck wintering areas (68%), and coastal waterbird colonies (54%) have the highest probabilities of being contacted by a spill. The most vulnerable coastal habitats are located along the western end of the south shore of Long Island, and Martha's Vineyard and Nantucket Island.

An estimated 13 oil spills greater than 1,000 barrels each may occur from proposed and existing OCS lease sales in the adjacent Mid-Atlantic region. Oil spills in the Mid-Atlantic region are not expected to have a significant cumulative impact on marine and coastal habitats impacted by OCS activities in the North Atlantic region (Compare Tables 10 and 16, Appendix D). However, due to the wide ranging and migratory behavior of most of the species occurring in the North Atlantic region, the high number of estimated spills in the Mid-Atlantic region will probably impact many of these species, especially sea ducks and pelagic birds. The cumulative effect of OCS activities in both the North and Mid-Atlantic regions could result in high mortalities of many marine bird species with probable long-term population declines. In addition, valuable marine and coastal habitats from Georges Bank to Cape Hatteras, N.C., may be degraded from exposure to one or more oil spills.

Impacts that are not related to OCS activities but could contribute to a cumulative impact to avian resources include the loss of nearshore and onshore habitats from private and recreational development which will pose a serious long term threat to wading birds and shorebirds in particular. Furthermore, transcontinental migratory species are protected and managed in accordance with international treaties. If OCS oil and gas development in the Mid-or North Atlantic regions adversely affects these species, it might constitute a violation of these treaties. Those species which migrate as far as Central and South America could be exposed to toxic substances like DDT which inhibit reproduction. Industrial and sewage sludge wastes from designated ocean dumpsites could have an adverse effect, especially on marine birds, by degrading the ocean environment. Marine birds will also be exposed to oil spills from oil imported into the Mid- and North Atlantic regions. An estimated 93 spills over 1,000 barrels each may occur over a 30 year period from oil imported into these regions (Table 1, Appendix D).

Conclusion: The cumulative impacts from the proposed Sale and existing OCS Sales and from activities unrelated to OCS exploration and production could result in high mortalities and possible population declines for all avian resources, especially marine bird species. Important habitats could be degraded from OCS and non-OCS related oil spills and from industrial and sewage sludge wastes from designated ocean dumpsites.

Alternative 2: Delay the Sale

To delay the sale may not decrease the risk of an oil spill impacting avian resources. Imported oil traffic will continue to pose a more significant threat to these resources than the OCS exploration and development expected from the proposed Sale. Potential impacts outlined under the proposal would not be significantly changed or reduced by a delay of the Sale. A delay could allow for additional studies to be conducted on population trends and distributions of pelagic birds. This information would aid in quantifying and mitigating impacts to these species from OCS activities.

Conclusion: To delay the sale would postpone impacts to birds, not prevent them. However, if more information was gathered pertaining to pelagic species, it might be possible to mitigate adverse impacts to these birds.

Alternative 3: Cancel the Sale

To cancel the proposed sale would decrease the chance of an oil spill from OCS-related oil and gas activites occurring and impacting avian resources. However, the probability of an OCS related oil spill occurring from existing lease sales and impacting avian resources will remain moderate to high (Table 15, Appendix D). Sea ducks and pelagic birds in the North Atlantic region could benefit significantly from a cancellation of proposed Sale No. 52, but imported oil in both the Mid- and North Atlantic region will continue to pose the more serious threat to these birds. The probabilities of one or more oil spills occurring and impacting avian resources from imported oil are listed in Table B-1, Appendix D. It has been estimated that 93 oil spills greater than 1,000 barrels each could occur in both region combined over a 30-year period. The estimated number of OCS-related oil spills (24) and imported oil spills (93) are not expected to be additive as OCS oil is projected to back out imported oil on an equal basis. Therefore, cancellation of the proposed Sale No. 52 should not have a net beneficial effect on avian resources when imported oil is considered.

Conclusion: Cancellation of the proposed Sale No. 52 would reduce the risk of OCS oil and gas activities adversely impacting birds. However, the overall risk to these resources are not expected to diminish significantly as imported oil will continue to pose the more serious threat to all avian resources in the area.

Alternative 4: Delete Tracts in Water Depths Greater Than 2000 Meters

Impacts to pelagic birds, sea duck wintering areas and coastal waterbird colonies are expected to be slightly reduced under this alternative as opposed to the proposal. Pelagic birds and sea ducks could benefit from the one less estimated oil spill over 1,000 barrels projected under this alternative. Impacts to marine birds from service vessel traffic and drill rig discharges, and impacts to wading birds and shorebirds from onshore development and OCS tanker traffic are not expected to change significantly from those identified under the proposal.

Conclusion: The deletion of 49 deep water tracts should slightly decrease the risk to birds, particularly marine birds, of being impacted by an OCS related oil spill. Other impacts identified under the proposal are not expected to change significantly.

Alternative 5: Modify the Proposal by Deleting Tracts to Protect Fisheries

Under alternative 5, the probabilities of an oil spill occurring and impacting pelagic birds in the Georges Bank crest area, sea duck wintering areas, and coastal waterbird colonies over a 30-year time period are 59.0%, 58%, and 47% respectively as opposed to 75% 64% and 51% under the proposal. Therefore, implementation of alternative 5 would tend to reduce the risk of an oil spill impacting the important habitats of these species. In addition, marine bird species could be exposed to fewer spills over 1,000 barrels as 8 spills are estimated to occur under this alternative as opposed to 10 under the proposal, assuming tankers will transport OCS oil to shore for each alternative. Impacts from onshore OCS related development should be minimal.

Conclusion: The risk to avian resources of being impacted by an OCS related oil spill would be less under alternative 5. This could be especially important for pelagic birds and sea ducks due to their great vulnerability to oil spill impacts.

Alternative 6: Modify the Proposal by Deleting Tracts in the Vicinity of Canyon Heads

Impacts to waterfowl, wading birds, and shorebirds under this alternative should not change from those identified under the proposal due to the small number of tracts that would be deleted (approximately 6.0% of the proposed sale area) and to their great distance from these avian resources. Pelagic birds, however, are known to concentrate in upwelling areas which would include canyon heads. Impacts from drill rig activities and regular discharges could be eliminated in these areas. However, overall impacts would not change significantly due to the small number of tracts that would be deleted and to the widespread distribution of these birds in general throughout the leasing area.

Conclusion: Implementation of this alternative would have no change in impacts to coastal and onshore avian resources from those identified under the proposal. Pelagic birds may benefit from a minor reduction in impacts from drill rig activities and discharges.

Alternative 7: Consideration of Marine Sanctuaries

The Georges Bank

Impacts to avian resources under a Sanutuary designation could be similar to those expected under alternative 5 but may be even more severe if oil is transported by pipeline to a mooring bouy servicing OCS tankers. The additional subsea pipeline required to handle crude oil recovered from the remaining portions of the lease area could pose an additional oil spill risk thereby increasing the probability of an oil spill occurring and impacting avian resources, especially marine bird species.

Conclusion: Implementation of a Sanctuary could result in impacts to avian resources that would be very similar to those expected under alternative 5 but may be even more severe.

ALTERNATIVE 8: MODIFY THE PROPOSAL BY DELETING 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Impacts to avain resources under this alternative could be moderately reduced due to the decrease in size (approximately 18.0%) of the proposed lease area. The probability of an OCS related oil spill occurring and impacting any avian resource would decline over the expected under the proposal. This factor combined with the fact that pelagic birds are the principal species occurring in the deletion areas could significantly reduce the impacts to these birds. Impacts from OCS onshore development should not change from those expected under the proposal.

Conclusion: Impacts to all avian resources could be moderately reduced under this alternative, especially for pelagic bird species.

8. Impact on Fishery Resources

Impact on fishery resources would arise mainly from three sources; oil spills, drill muds and cuttings, and formation waters. The following analysis treats each of these causes of impact separately and then aggregates their total effect. Cumulative effect of this proposed Sale, Sale No. 42, existing tankering and other sources is also assessed.

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

Offshore Oil Spills

The productivity of Georges Bank fishery resources, which include demersal species (cod, haddock, flounder), and benthic species (lobster, scallops, and clams), appears to result from a unique combination of oceanographic conditions in the area. The area is characterized by a semi-enclosed gyre, strong upwelling and vertical mixing. These physical oceanographic conditions tend to concentrate nutrients, retain plankton, and cause eggs and larvae to be retained in this area of high productivity, considered the crest of Georges Bank. For example, haddock is an important fishery on Georges Bank. It is felt that most pelagic haddock eggs drift off the Bank and are lost to the population except in years of unusual hydrographic conditions that lead to a strong year-class (Colton and Temple, 1961).

The projected number of spills from OSTAM (Oil Spill Trajectory Analysis Model) over the assumed 30-year life of the field is 10. The probability of a spill greater than 1000 barrels occurring and impacting the Georges Bank crest over the production life of the field is 75%. The amount of biological damage will depend on many factors including: 1) physical and chemical characteristics of the oil, 2) the amount of oil spilled, 3) environmental conditions such as sea state, temperature, salinity, and 4) the biological characteristics of the organism, life stage, season, and previous exposure to oil.

Fish spawn on Georges Bank almost all year long (see Section III.B.3 for specific fish spawning times). Timing would be a critical factor in determining which species or year class would be impacted. Hufford (1971) and others reported that crude and bunker oil were toxic to fish eggs at concentrations of 1 ppm (parts per million). Also, major behavioral abnormalities were reported in larvae at levels of 0.001 ppm. A spill impact on a poor year-class could be severe. Unsuccessful year classes are due to poor natural environmental conditions for larvae development and survival. The recovery of the year class would be greatly dependent on succeeding hydrographic conditions of the following years which would be the critical factor in the recovery of the specific fish resource. A possible oil spill could suppress survival of a year-class but natural variability ranging from 40% to 80% is not at all uncommon for laval mortalities on Georges Bank. It is possible that if the population level of a given species is significantly reduced, other competing species could move into the vacated niche, thus reducing the probability of recovery of the impacted species. For example, the cod and haddock are closely related in habitat as well as taxonomy. Haddock was traditionally fished in preference to cod because of its higher market value, the latter being landed primarily as by-catch. The virtual collapse of the haddock stock in the 1960's may have been accompanied by an increase in the cod population, which would explain why the haddock has not regained its prominence on Georges Bank, despite

regulatory controls by the New England Fishery Management Council. Similarly, any major impact by an oil spill affecting one element of the food web could result in significant shifts throughout the ecological system.

If numerous sexually mature animals die from direct coating or toxicity, the size and reproductive potential of the population could be significantly reduced. North et. al. (1965) and Eberling et. al. (1970) reported fish may be less vulnerable to spills than other groups of aquatic organisms because of their mobility and avoidance reactions. Visual No. 5 shows important grounds for 16 species of fish and shellfish in relation to the proposed Sale area. Important areas for yellowtail flounder, lobster, and red crab are found in the proposed Sale area but adults would not be expected to be directly affected because of avoidance reactions or demersal habitats. Effects of habitat alteration due to oil is discussed in Section IV.C.4 - Impacts on Benthos. Thus, from the proposed sale, little direct impact on adult populations would be expected due to direct coating from an oil spill.

Impacts Inshore

Numerous species are dependent upon the estuaries for developmental stages or as a passageway going to and from fresh water for spawning. These include winter and summer flounder, striped bass, shad, smelt, black sea bass, bluefish, American eel, weakfish, and others. The probability of an oil spill from the proposed Sale impacting any of the major estuaries, coastal marshes, or protected coastal areas is less than 0.5% (Table 5, Appendix D). The probability of a proposed Sale No. 52 tanker spill impacting any of the major estuaries, coastal marshes, or protected coastal areas is 1% or less, 17% or less, and 17% or less, respectively. The marshes and protected coastal areas most vulnerable to a proposed Sale No. 52 tanker spill are those along the northern New Jersey shore and the south shore of Long Island approaching Raritan Bay. A spill may have a serious impact upon a local population, but most species have broad geographical ranges, and a spill from the proposed Sale which enters a single bay or salt pond should not have a significant effect on the total population. Impacts to commercially important bay scallops, lobster (inshore), and hard and soft clams are discussed in Section IV.C.9.

The most important specie harvested by marine sports fishermen in New England and New York is bluefish, approximately 20% by weight. The bluefishis a warm-water seasonal migrant with its northern limit off Massachusetts. Bluefish spawn on the outer shelf from May to June, and by late July and August post-spawning adults return to the inshore feeding grounds. Bluefish are highly prized by anglers as excellent sports fish and are heavily fished in southern Massachusetts coastal waters. The probability of a spill occurring and impacting the southern Massachusetts coast over the life of the field is 3%, An inshore spill during the months of July and August would disperse the inshore population and have an economic and recreational impact on the local sports fishery. An inshore spill

would most likely result from existing transportation of refined products (fuel oil and gasoline) to New England. Factors which influence the degree of biological damage from a spill have been summarized in the FEIS for Sale No. 42 and Boesch et. al. (1974) and include the type of oil, amount and rate of spillage, weather conditions, season and clean-up methods used. A spill from the proposed Sale during the months of July and August would be expected to move toward the south from the proposed Sale area. Therefore, the possibility of an oil spill from the proposed Sale impacting the recreational bluefish activities inshore is remote. Possible impacts to other important recreational fisheries such as striped bass or mackerel would also be remote because of their wide distribution.

Blackback flounder is unique, being susceptible to an inshore oil spill because it spawns demersal eggs nearshore and also being an important commercial species on Georges Bank. Blackback flounder occurs in coastal waters and on offshore banks from Newfoundland to Cape Hatteras, North Carolina. Spawning occurs from January to May, primarily inshore in shallow waters on sandy bottoms but also on Georges Bank and Nantucket Shoals. The eggs are demersal and stick in clusters. Any oil impacts inshore during January to May from the proposed Sale could affect a localized stock of blackback flounder. Considering the areal extent of spawning grounds, any impact should be of a localized nature. If oil contacts the inshore sediments, this could affect successive egg survival for a period of 10 years or more. Blackback flounder are distributed along broad geographical ranges and a spill within any single bay would not have any significant impact on the total population.

Drilling Muds and Cuttings

In areas with relatively moderate currents, such as on the continental slope in the proposed Sale area, fish congregating around a drilling platform could experience some degree of sublethal stress unless they actively avoid the plume. On Georges Bank, the highly energetic environment will rapidly disperse the plume within 100 meters, making it very unlikely that any fish will remain in the plume for a significant period of time.

Menzie et. al. (1980) observed that sessile bottom fauna in the immediate vicinity (150 m) of a drill rig in the Baltimore Canyon were buried by patches of drill cuttings while simultaneously there occurred increased numbers of hake and crabs in the area. This effect was considered temporary in that the clay deposits are expected to be reworked by currents. Hake are bottom feeders and are not expected to suffer any sublethal stress from the plume. Hake and crabs were attracted to the pile of drill cuttings which temporarily accumulated beneath the rig.

It is possible that the initial concentration of discharge could cause some mortalities of larval crustaceans (lobster, crabs), if they enter the plume at a highly sensitive stage of molting. Carls and Rice (1981) reported that the most evident immediate response of larval crustaceans upon exposure to high concentrations of whole muds was to reduce swimming activity; however, significant numbers did not cease swimming activity until exposed to relatively high concentrations for at least four hours. Sensitivity of fish eggs and larvae to drilling fluids

have not been reported in the literature, but is likely to be no greater than those of the most sensitive larval crustaceans, and their exposure would be similarly brief. Visual No. 5 shows important spawning areas on Georges Bank. Hake spawning grounds are located partly inside the proposed Sale area. The percentage of any ichthyoplankton potentially affected would be negligible because of the energetic environment of Georges Bank. To protect the early life stages (eggs and larvae), the NPDES permits for Sale No. 42 required that the discharge be shunted to a depth of 10 m, that the discharge be pre-mixed with sea water at a 10:1 ratio, and that discharges do not exceed a maximum rate of 30 barrels per hour. If these measures are effective and needed, similar mitigating measures for protecting the fishery resources on Georges Bank could be implemented for the proposed Sale. The objectives are to dilute the discharge prior to entering the water column and to keep the discharge below the maximum concentration of eggs and larvae in the water column.

Significant bioaccumulation of heavy metals in fish is not expected due to the high mobility of fish and the nature and duration of the discharges. The exception may be found in populations of fish that are attracted to and remain in the vicinity of the drilling vessel for a period of several weeks or months. These fish may browse or otherwise feed on rig-fouling organisms that may contain elevated levels of some metals. This would be more likely around a production platform where a number of wells may be drilled over periods of several years. This attraction of fish around a rig was observed in the Baltimore Canyon (Menzie et. al., 1980). In the mean case, 20 platforms are estimated over the lifetime of the field. The likelihood of significant impacts on fish from drilling muds and cuttings is remote but the potential exists that some platform-associated fish could incorporate some heavy metals into their tissues to a limited extent.

Formation Waters

Water associated with oil and gas pools, called formation waters, are often produced during oil and gas production. Over the 30-year production life of the field, 1.7 billion barrels are expected to be discharged from 20 production platforms. Formation waters contain hydrocarbons, dissolved mineral salts, heavy metals, are denser than seawater and lack oxygen. The first year of production could result in an equivalent of 2,376 barrels of oil being discharged with a peak year of 4,342 barrels of oil associated with discharged formation waters. Dilution models have indicated that the areal extent of increased hydrocarbon levels around a platform will be 0.1 square miles for concentrations over 10 ppb, and 0.001 square miles for a concentration over 1 ppm (Massachusetts Institute of Technology, 1973). Kunhold (1977) found no noticeable effects on cod larvae at levels of 10 ppb. Hufford (1971) and others reported that crude and bunker oils were toxic to fish eggs in concentrations of 1 ppm. Therefore, impacts to ichthyoplankton would be very localized: approximately 0.001 square miles around the 20 expected production platforms from the proposed Sale.

Conclusion: An oil spill could cause a serious population decline in one or more species if it coincides with spawning and a poor year-class. However, the probability is uncertain. The fishery resources could recover, depending upon succeeding oceanographic conditions. The unique occurrence of those onditions is uncertain.

CUMULATIVE IMPACTS

Operations related to proposed Sale No. 52 are assumed to include 17 exploration wells, 26 delineation wells, and 473 development wells over the life of the field. In addition, Sale No. 42-related operations are assumed to include 10 exploration wells, 5 delineation wells, and 78 development wells. OSTAM predicts one major spill greater than 1000 barrels could occur as a result of Sale No. 42, while 10 major spills are predicted during proposed Sale No. 52 operations. Operations from both could result in cumulative impacts on fishery resources due to oil spills and chronic discharges drom drilling vessels, platforms and transport vessels. Overall, cumulative impacts on fishery from Sale No. 42 and the proposed Sale would come primarily from the proposed action due to the large size of the sale area, greater resource estimates (see Section I.A.1), and projected number of oil spills.

An estimated 13 oil spills greater than 1,000 barrels are expected to occur from proposed Sale No. 59 and existing OCS lease sales in the adjacent Mid-Atlantic region. Oil spills in the Mid-Atlantic are not expected to have any effect on fishery resources in the North Atlantic region (compare Tables 10 and 16, OSTAM, Appendix D).

Ninety-three (93) oil tanker spills greater than 1,000 barrels are expected over a 30-year period from existing oil imports in the North and Mid-Atlantic. OCS oil is expected to replace some of the foreign oil, thereby reducing the number of possible spills from existing tankers. The majority of oil tanker spills occur during loading and offloading operations or when navigationg in restricted passageways. None of the tracts tentatively selected lies within a Traffic Separation Scheme, a Precautionary Area, or the Nantucket Shoals area. (see Visual No. 1).

Conclusion: Should a serious oil spill occur, some fisheries resources will be impacted. OCS oil from the proposed Sale is expected to replace some imported oil so possible impacts due to an oil spill should not substantially increase. The cumulative effect of drilling muds and cuttings should have little effect on fish eggs and larvae. There could be some decline to the fishery resources due to these cumulative OCS activities and existing tankering of oil.

ALTERNATIVE 2: DELAY THE SALE

Delaying the proposed Sale may not decrease the risk of an oil spill impacting the fishery resources of Georges Bank. Imported oil traffic will continue to pose a threat to these resources. Potential impacts outlined under Alternative 1 would not be significantly changed or reduced by delaying the sale. A delay could allow for additional studies to be conducted on population trends and distribution of fishery resources. This information could aid in quantifying and mitigating impacts to fishery resources from OCS activities.

Conclusion: To delay the proposed Sale would postpone impacts to fishery resources, not prevent them.

ALTERNATIVE 3: CANCEL THE SALE

To cancel the proposed Sale would eliminate any chance of an oil spill occurring and impacting the fishery resources on Georges Bank from OCS proposed Sale No. 52 oil and gas activities. Discharges from the proposed Sale, expected to be 11,601,962 barrels of drilling muds and 1,840,691 barrels of drill cuttings, would be eliminated. Because exploration and development is scheduled for Sale No. 42, all impacts to fishery resources due to OCS drilling on Georges Bank would not be eliminated. Imported oil and domestic oil from other regions would continue to be tankered through the north Atlantic, posing a threat to the fishery resources on Georges Bank and continuing the existing level of potential impact in the region.

Conclusion: Cancellation of the proposed Sale No. 52 would significantly reduce the risk of OCS oil and gas activities adversely impacting fishery resources. Imported oil would continue to pose a threat to all fishery resources in the area.

ALTERNATIVE 4: DELETE 49 TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

Deletion of 49 tracts in water depths greater than 2000 meters contitutes only a 9 percent reduction in the proposed Sale area. No important spawning grounds are located in this proposed deleted area. The major spawning grounds are located on Georges Bank in water depths less than 200 meters (see Visual No. 5). The effect on fishery resources would not be substantially reduced from that described for Alternative 1.

Conclusion: The impact to fishery resources under this alternative would only be slightly less than Alternative 1.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts or 36 percent of the proposed Sale area would leave 335 tracts in deeper water on the continental slope and rise under this alternative.

Under this alternative, 69 fewer production wells and 7 fewer platforms would be expected, with 248,262 less barrels of drilling muds being discharged in the proposed Sale shelf area. Impacts to the continental slope and rise from drill muds and cuttings would be the same as Alternative 1. The majority of expected impacts from chronic discharges discussed under Alternative 1 would be eliminated on the continental shelf because the 335 tracts left are in deeper water on the continental slope and rise. Thirty-three of the 205 tracts deleted under this alternative are located at the heads of canyons within the proposed Sale area. This alternative would protect important coral, lobster, and tilefish populations and the integrity of the canyon ecosystems within the proposed Sale area.

The physical oceanographic conditions of the Georges Bank crest are believed to lead to the retention of fish eggs and larvae. Any oil spill impacting this area during spawning could have a significant impact on that particular fishery resource. Under

this alternative, the probabilities of an oil spill occurring and impacting the Georges Bank crest over a 30-year period is 59% as opposed to 75% under Alternative 1. Also, with 69 production wells and 7 fewer platforms being eliminated from the shelf region chronic discharges onto the shelf area would be virtually eliminated.

Conclusion: Deletion of these 205 tracts would greatly reduce the potential effect on fishery resources within the 200 meter isobath and in canyon heads.

ALTERNATIVE 6: DELETE 33 TRACTS IN CANYON HEADS

This alternative would delete 33 tracts in canyon heads from the proposed Sale. Canyon heads are important areas for fishery resources. Lobsters are found on virtually all parts of Georges Bank, with highest concentrations in the canyon heads along the southern tier. Deletion of these 33 tracts would protect the heads of Veatch, Hydrographer, Welker, Oceanographer, Gilbert, Lydonia, and Powell canyons from direct impacts due to drill muds and cuttings. Hecker et. al. (1980, BLM ESP) reported on the distribution and abundance of various animals including soft and hard corals in about 10 submarine canyons which included Oceanographer and Lydonia canyons within the proposed Sale area. They noted faunal densities higher than on the continental slope, suggesting that this is probably a consequence of higher nutrient flux and greater substrate variability. Increased suspended sediments due to drilling muds and cuttings can damage coral populations by covering rocks, fouling the colonies, or abrading their tissues. This damage would be virtually eliminated by Alternative 6. This alternative would also eliminate the amount of drilling-related discharges that could possible be transported to deeper canyon areas. This alternative would also protect tilefish populations within the canyon environments.

Conclusion: Deletion of these 33 tracts would virtually eliminate direct impacts to lobster, tilefish and coral resources within the canyons in the proposed Sale area.

ALTERNATIVE 7: GEORGES BANK AS A MARINE SANCTUARY

Three major restrictions are considered for oil and gas activities within the marine sanctuary: 1) the barging of drilling muds and cuttings from the heads of canyons, 2) discharging under NPDES permit requirements for Sale No. 42 and 3) pipelining of oil to a moored buoy outside the sanctuary.

The barging of drilling muds and cuttings near seven canyon heads within the proposed Sale area. Thirty-three tracts lie at or near the heads of Powell, Lydonia, Hydrographer, Oceanographer, Welker, Gilbert, and Veatch canyons in water depths from 160 meters to 825 meters (see Figure II.B.6-1). These are important areas for lobsters, tilefish and coral resources. Possible direct impacts from drilling muds and cuttings would be virtually eliminated.

Control discharges in the 205 tracts of the proposed Sale that are within the sanctuary boundary as required under EPA NPDES permits for Sale No. 42 on Georges Bank; these restrictions require that discharges do not exceed a maximum rate of 30 barrels per hour, be pre-mixed with seawater at a 10:1 ratio, and discharged at a depth greater than 10 meters. The objective is to dilute the discharge prior to entering the water column, eliminate bulk drilling-mud dumps, and to keep the discharge below the depth of maximum concentrations of fish eggs and larvae. This would greatly decrease possible impacts to ichthyoplankton from drill muds and cuttings.

Pipelining of oil to a moored buoy outside the sanctuary and tankering to existing refineries in the Mid-Atlantic and Gulf of Mexico would eliminate any impact from chronic discharges associated with the onloading of tankers within the sanctuary.

Conclusion: These restrictions on oil and gas development would significantly reduce the potential impacts to fishery resources on Georges Bank.

ALTERNATIVE 8: MODIFY THE PROPOSAL BY DELETING 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Impacts to fishery resources under this alternative would be slightly reduced to the decrease in size (approximately 18%) of the proposed Sale area. The major spawning grounds are located on Georges Bank in water depths less than 200 m (see Visual No. 5). All of the tracts to be deleted under Alternative 8 are located on the continental slope away from the important fisheries areas. Therefore, any impact on fishery will be similar to Alternative 1.

Conclusion: Impacts to fishery resources will be similar to Alternative 1.

Conclusion: Impacts to fishery resources will be similar to Alternative 1.

9. Impacts on Commercial Fisheries

ALTERNATIVE 1: HOLD THE SALE AS PROPOSED

The impact to commercial fisheries will primarily come from oil spills and spacial exclusion due to the placement of rigs, platforms, and gas pipelines. The following analysis treats each separately and then aggregates their total effect. Cumulative effect of this proposed sale, Sale No. 42, existing tankering and other sources is also assessed.

Offshore-Oil Spills

Nelson-Smith (1972) suggested that actively swimming species avoid contamination since significant fish kills have not been observed following offshore oil spills. Based on these avoidance reactions, mortality of adult fin fish is not expected to be significant, but impacts on eggs and larvae could have an important effect on the commercial fisheries.

Reed, Spaulding, and Cornillon (1980) developed an oil spill-fishery interaction model to estimate the impacts of offshore oil spills on a commercially fished stock. A fishery model for cod (*Gadus morhua*) on Georges Bank was implemented with an ocean transport model to simulate the distribution of eggs and larvae, and an oil spill behavior and fates model. An oil tanker spill of 10 million gallons was simulated with a uniform release rate over a 36-hour period. Cod spawn on Georges Bank during the winter. Therefore, the simulation was run for December 15th with the spill occurring in the middle of the cod-spawning area. In actuality, cod-spawning areas are outside the proposed Sale area (See Visual 5). This spill can be compared with the Argo Merchant wreck in which 7.7 million gallons of No. 6 oil was released over about 6 days but which had little impact because the spill moved away from Georges Bank. Oil induced mortality was assumed to occur whenever eggs or larvae enter an area in which total concentration, including entrained and dissolved constituents, exceeds a threshold value. The values used were 50, 100, and 1000 parts per billion (ppb), the lower value being the limit at which statistically significant results can be obtained from the oil behavior and fates model. The 50 ppb value is somewhat higher than the 10 ppb level at which Kunhold (1977) observed no noticeable effects on cod larvae, and 1000 ppb appears to be well into the lethal range for soluble aromatics (Malins, 1977; Hyland and Schneider, 1976).

The magnitudes of the impacts on cod were estimated to range between 0% and 10% of the annual maximum sustainable commercial yield of approximately 25,000 metric tons, or up to $2.5 million (in 1979 dollars) in reduced income to the fishing fleet. The vast majority of the commercially important species on Georges Bank, including cod, haddock, pollock, hake, herring, flounder, mackerel, lobster, crab and sea scallop have pelagic eggs and/or larvae. Depending of the specific biological patterns associated with each of these species, the total cost of a spill in terms of reduction in catch could greatly exceed model values of 2.5 million dollars.

BLM is currently funding a study to quantify the impacts of oil spills on selected fish populations on Georges Bank and to evaluate the economic loss due to oil spills. The preliminary results imply that oil spills will not cause massive losses to the fisheries. Nevertheless, long term effects could be very different if the oil spill coincides with a poor year class due to unfavorable natural environmental conditions for larval development and survival.

The spill drift was found to be a strong function of season but only weakly dependent on spill location or size. In general, spring spills (surface/subsurface) drift toward the northeast, winter spills toward the west/northwest, while summer and fall spills are directed south or southwest away from the most important commercial fisheries (see Visual No.5). it would be expected that winter and spring spills would have the greatest impact on commercial fisheries. Spawning occurs all year long on Georges Bank (see Section III.B.3). Spawning activity is greatest for most species from late winter to mid-summer. Exact timing of a spill appears to be a major determinant in what species will be impacted, the total amount of oil and location of spill were less important factors in determining possible impacts on a specific species.

It is unlikely that fishermen will harvest in the area or an oil spill; but most fishermen will be able to fish in other areas. Economic losses also would be incurred by support, processing, transportation and marketing industries. Mitigation is provided by OCS Order No. 7 which requires that each oil company develop oil spill contingency plans and have ready access to pollution-control equipment. In compliance with OCS Order No. 7, the first drilling rig on-site within the currently leased area will maintain onboard a skimming barrier, a Fast Response Unit, and a Dracone Flexible Barge, as well as trained personnel to initiate clean-up response and deployment of the equipment. This equipment will be maintained offshore for the duration of drilling and thereby stands ready to provide rapid clean-up response for an oil spill within the proposed Sale area. For further information concerning oil spill containment clean-up capabilities and its limitations, see Section I.C.3. The Offshore Oil Pollution Compensation Fund and Fishermen's Contingency Fund were created to compensate for these and other losses (See Section I.B.1.c).

Impacts-Inshore

Six commercially valuable shellfish were treated in the OSTAM model: bay scallops blue crabs, oysters, lobster (inshore), and hard and soft clams. Risks of a spill greater than 1000 barrels occurring and impacting these resources over a 30 year lifetime of the field range from 51% for the hard clam grounds to less than 0.5% for important blue crab areas. The probability that these shellfish areas will be impacted from proposed tankering routes (See Appendix D) range from 12% to less than 0.5%.

Hard clam grounds are found primarily within an area extending from Cape Cod south to Cape Hatteras, North Carolina. The industry is centered in the Great South Bay on Long Island. The probability of a spill occurring and reaching the south shore of Suffolk County (which includes Fire Island Inlet) from proposed tanker routes is less than 0.5%. An oil spill could be moved by tidal action through Fire Island Inlet, but oil containment equipment is stored in the immediate vicinity. The possibility of impacting this important commercial and recreational resource can be virtually eliminated inshore by proper use of oil containment equipment.

Many of the most productive hard clam grounds in Narragansett Bay have been closed due to pollution. This species is essentially estuarine, inhibiting shallow bays and coves along the Rhode Island coast. The probability of an oil spill occurring and impacting the Rhode Island coast is low, (1 to 3%). However, if the sediments were contaminated due to an oil spill, recruitment to the hard clam populations would be affected for up to 10 years or more with commercial clamming activities curtailed.

Important soft clam populations are located in the upper reaches of Narragansett Bay. These populations are not considered susceptible to an oil spill originating from the proposed Sale due to their distant location from the proposed sale area. An oil spill could be moved by tidal action through the mouth of Narragansett Bay but cleanup equipment is available at Davisville, among other locations (See Section I.A.3). Other locations of soft clams are located throughout the region and would be more exposed to an oil spill but these populations tend to be smaller and more isolated.

The most important populations of bay scallops occur from Cape Cod to Barnegat Bay, New Jersey. The most valuable fishing grounds are in New York waters; principally Gardiners, Peconic and adjoining bays. The probability of a spill occurring and impacting the entranceway to Peconic and the adjoining bays is less than 0.5%. The probability that this area will be impacted from proposed tanker traffic is also less than 0.5%. The probability of occurrence is low but contamination could remain for a few years and affect recruitment because of the isolation of the breeding stock, curtailing any recreational or commercial activities. Large populations of bay scallops and smaller ones of hard clams are found in the shoal areas adjacent to Nantucket Island and Martha's Vineyard. These populations would be susceptible to an offshore oil spill but would be expected to recover. Contaminated sediment could affect recruitment of bay scallops for up to 10 years or more. Renumeration of this economic loss would be available under Title III-Offshore Oil Spill Pollution Fund (OCS Lands Act Amendments of 1978) (See Section I.B.1.c).

The most significant quantities of blue crabs occur along the Mid-Atlantic coast near the Delmarva Peninsula and within and at the mouth of the Chesapeake Bay. An oil spill would be especially harmful during the winter which could kill overwintering females or during the summer when larvae could

be impacted. Either possibility would probably result in a year class failure which could seriously impact the commercial fishery, but the probability of a spill occurring and impacting either area or from proposed tanker routes for the proposed Sale area is less than 0.5%.

Commercial quantities of oysters are found in Delaware Bay and Long Island Sound, with a secondary population near the Delmarva Peninsula. OCS Sale No. 52 related tankering routes are expected to enter Delaware Bay. The possibility of impact from the proposed tanker route for the mouth of Delaware Bay and the Delmarva Peninsula is 10%. The probability of a spill occurring and impacting the entrance way to Long Island Sound is less than 0.5% from the proposed tanker route (T28-T31) and impacting the entrance way to Long Island Sound is also less than 0.5%.

Inshore lobster can be found throughout the New England coastal waters. However, fishing pressure and pollution have greatly reduced the local populations (Beccasio, 1980). If sediment contamination does occur, lobsters, being scavengers would have a reduced food supply and tainting could occur from feeding on contaminated organic matter. Sediment contamination from an oil spill could affect the local lobster population for up to 10 years or more. This would require inshore lobstermen to move their pots to other areas and increase fishing pressure on other local populations already under intense fishing pressures.

Oiled sediments can be resuspended and transported to regions outside the original spill area (Blumer and Sass, 1972, a.b; Grose and Mattson, 1977) contaminating other areas. Once the oil is incorporated into the sediment it tends to persist, requiring a much larger time for the affected area to return to normal biotic distribution (Moore et. al., 1974; Vandermeullen and Gordon, 1976). However, for sandy sediments such as Georges Bank, the Council on Environmental Quality (1974) estimated the recovery time to be two to three years. During this period, the area would be less suitable for species with demersal eggs such as winter flounder and sea herring.

Spacial Exclusion

Platforms and Rigs: The placement of rigs, platforms and subsea completions as a consequence of the proposed Sale will restrict some portion of the area now being utilized for commercial fishing. The size of area which will be effectively precluded to fishermen will depend on many factors which include OCS equipment, vessel maneuverability, gear used, weather and sea conditions, legal and safety requirements, bottom topography (trawlers generally follow depth contours), a fishermen's experience, and his willingness to trawl near OCS structures. Structures such as subsea production systems preclude space for bottom fishing only and not mid-water trawls or longlining. However, the buffer zone around these subsea structures will also be affected by the navigational accuracy with which a fisherman can determine his position relative to the obstruction. If fishermen know the location of these structures, they would avoid them unless there is good reason or financial incentive to fish neaby. Under the mean case scenario, the number of development platforms and subsea production complexes are 20, and 31, respectively.

Only 6 tracts are located on top of the bank in water depths less than 60 meters. Oil or gas discoveries on the shelf area (32.5% of the proposed tracts) may be developed using conventional steel jacket or gravity structures. The slope area, beyond the reach of conventional recovery techniques may result in developmental schemes employing subsea completion wellheads and manifolds linked to tension leg platforms (Centaur, BLM ESP). Most subsea completion components are coupled with surface facilities for either processing, storage, or transport functions. A single sea floor template may have dimensions as small as 15m by 15m. The actual position of subsea wellheads around a common gathering manifold would depend heavily on the areal extent of the reservoir (Centaur, BLM ESP). The majority of these are expected to be on the continental slope and not in areas of greatest fishing activity. Some spacial exclusion will occur to the lobster and red crab fisheries. Instances of fishing gear catching on any of approximately 141 wellheads in the North Sea have not been a serious problem, and the success rate in wellhead avoidance may be largely attributed to protective triangular shaped cages being placed over submerged wellheads located in fishing areas (Centaur, BLM ESP).

OCS Orders No. 1 and 3 require that the U.S. Coast Guard District Commander determine what aid to navigation devices are needed for subsea wellheads that are hazards to the deployment of commercial fishing gear. The proposed wells and pipeline stipulation require that subsea wellheads be protected, if feasible,to be compatible with commercial fishing gear.

In the mean case scenario, three conventional oil platforms are expected to be sited in areas of high fishing activity on Georges Bank. Thirteen tension-leg platforms (TLP) are expected in the deeper areas of the continental slope and rise. The TLP that will be installed in the Hutton field of the North Sea has deck dimensions of 92.6 m by 74 m, equating to an area of 6,850 m2 which would be excluded from fishing. The tension-leg platforms are expected to be used in the deeper areas of the proposed Sale, away from areas of highest fishing activity. Four guyed-towers are expected to be used during the life of the proposed Sale. A guyed tower scheduled to be installed in waters over 300 meters in the Gulf of Mexico will have a deck cross-section of 2,5000 m2 and the sea floor space utilized by the guy cables which would be excluded from fishing is effectively 0.08 km2.

Tuna and swordfish longlining occurs to a limited extent in the proposed Sale area. The longlines are typically 5 miles long and left out for several hours. It is not believed that extensive gear conflicts will result due to the fact that the worst situation would only require the cutting of the line. Cutting of the line results in a small expense and occurs frequently under normal operating conditions. In addition, the potential exists for lines to be anchored to eliminate drifting towards an OCS structure (Centaur, Vol. 1, BLM ESP).

Construction of oil and gas facilities in the North Sea has created three areas of potential conflict between the oil industry and the local fishing industry 1) damage from debris left on the ocean bottom during construction of pipelines, wellheads, and platforms, from the operation of rigs and from supply vessels; 2) loss of access of space resulting from platform, wellhead and pipeline installations; 3) damage to undersea oil and gas structures resulting from use by the fishing industry of fishing gear.

Between 1974 and 1979, 502 compensation claims by fishermen have been placed with the UK Offshore Operating Association against the oil industry. The bulk of the claims result from fishing trawlers catching their nets and equipment on debris such as oil drums, scrap metal, lengths of steel cable, steel superstructure , and heavy equipment dumped overboard. Other types of debris that cause problems to fishermen include exposed boulders and heaps of heavy clay created by pipeline trenching activities and piles of crushed stone used to cover pipelines which become exposed or were never covered by natural backfill. Compensation funds have been established to allow fishermen to recoup some or all of the cost of replacing gear damaged by debris which cannot be identified as belonging to a specific company. Of the 502 claims filed 405 were settled, 69 rejected and 28 still being considered (Centaur, Vol. II, BLM ESP). In Norway, debris claims are immediately paid by the government which then investigates the fishermen's claim, locates the responsible company involved, and then demands payment.

The Fishermen's Contingency Fund established under the OCS Lands Act Amendments of 1978 permits commercial fishing vessels to be reimbursed for lost or damaged equipment as a result of OCS development. The fund may also pay for economic loss (i.e., loss of profits) associated with gear damage. If the object causing the damage appears on a navigational chart, is listed in the Local Notice to Mariners, or is marked by a surface buoy, float or marker, then it is considered negligence on the part of the claimant and no compensation will be made.

Pipeline Placement

Many of the fish and shellfish harvested are present along the assumed gas pipeline corridors (See Appendix C) and are principally caught by bottom trawling and dredging. It is important that pipelines be compatible with fishing because they often traverse a large area. For the mean case in the proposed Sale, two gas pipelines are projected with a length of 200 miles each. Proposed Stipulation No. 3 states that where feasible and environmentally preferable, all pipelines, including both flow lines and gathering lines be buried to a depth suitable for adequate protection from water currents, sand waves, storm scouring, fisheries trawling gear, and other factors as determined on a case-by-case basis. Unburied pipelines will need to have smooth surface designs and some type of protection over irregular surfaces to be compatible with fishing gear. Therefore, conflicts between pipelines and commercial fishing activities are not expected.

According to Broussard (1979), the main conclusions from the construction of the Flag pipeline in the North Sea showed that repeated contact with the heaviest fishing gear had no significant effect on the integrity of the pipeline. Also, pipeline trenching in deep water increased the loads on fishing gear moving across a pipeline. Trenching produced additional seabed debris due to anchors used by the barge as well as spoil from the trench.

Catch-Loss Model

A BLM funded study "Assessment of Space and Use Conflicts Between the Fishing and Oil Industry" (Vol. VI-Centaur, BLM ESP) is a catch-loss model done for the proposed Sale estimating the loss of catch to the commercial fishing industry due to OCS structures located on the fishing grounds of Georges Bank. Assumed distances that fishermen would avoid, for the sake of the model were 0.5 miles for drilling rigs and platforms (this includes 0.25 miles for the actual buffer zone and 0.25 miles for the extent of an anchoring system or satelite subsea completion) and 0.25 miles for pipelines. Many of the structures will be subsea completion and tension leg platforms without the need for extended anchoring systems. Buffer zones around pipelines may not be needed if the pipelines are compatible with commercial trawling activities.

Table IV.C.9.1 shows the range of area loss, catch loss, and associated dollar loss from the catch-loss model over three levels of development for proposed Sale No. 52. The mean represents the scenario most likely under this Alternative. The greatest percentage of catch under the mean case that would be lost is 2.03% for the groundfish otter trawl (flounder) for which the model considers blackback and yellowtail flounders, sand dab, gray sole and lemon sole. Therefore, little spacial conflicts is expected between the fishing industry and the proposed Sale.

Table IV.C.9.1

Minimum and Maximum Losses
Expected With Different Levels of OCS
Activity in the North Atlantic
Lease Sale No. 52

Fishery		Percent of Area Lost	Percent of Catch Lost	Dollar Loss (thousands)
Groundfish Otter Trawl (Flounder)				
	Maximum	2.64	0.13	31.686
	Mean	2.04	0.10	24.452
	Minimum	0.01	0.00	0.075
Other Groundfish Otter Trawl				
	Maximum	2.32	0.00	1.218
	Mean	1.76	0.00	0.929
	Minimum	0.00	0.00	0.002
Ocean Quahog/Surf Clam				
	Maximum	2.20	0.22	7.703
	Mean	1.76	0.18	6.153
	Minimum	0.01	0.00	0.041
Sea Scallop				
	Maximum	1.13	0.14	40.822
	Mean	0.92	0.11	33.195
	Minimum	0.01	0.00	0.283

Table IV.C.9.1 (cont.)

Minimum and Maximum Losses
Expected With Different Levels of OCS
Activity in the North Atlantic
Lease Sale No. 52

Fishery	Percent of Area Lost	Percent of Catch Lost	Dollar Loss (thousands)
Lobster Otter Trawl			
Maximum	1.65	0.50	17.832
Mean	1.36	0.41	14.727
Minimum	0.01	0.00	0.148

OCS Activities

	Platforms	Drilling Rigs	Miles of Truckline	Miles of Connecting Line
Maximum	30	0	400	113
Mean	20	0	300	103
Minimum	1	0		

Source: Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Vol. IV (BLM ESP).

Foreign Fishing

The Atlantic coast foreign fishing vessels are primarily directed toward squid (Illex and Loligo), butterfish, mackerel, and hake with some by-catches of other finfish. Foreign fishing vessels are also restricted to where they may fish (Visual No. 5). Regulation of the foreign fishing in the North Atlantic comes under the purview of the North Atlantic Fishery Management Council. The portion of the "optimum yield" which the U.S. is capable of harvesting and processing is assigned to the U.S. fishermen. The remainder is distributed among those foreign countries which have developed agreements with the U.S. under the provisions of the Fishery Conservation and Management Act of 1976. In addition to the imposition of quotas, other restrictions include 1) fish size 2) fishing gear 3) fishing area and 4) seasons. Spacial exclusion, as previously explained, is not of significance to domestic commercial fishermen. There is some area overlap between foreign fishing grounds and the proposed Sale area (see Visual No. 5). Foreign fishing is primarily determined by a quota system. Thus, a slight increase in fishing pressure should negate any conflicts due to spacial loss.

Fishing Port Conflicts

Volume V of the Centaur Report (1981, BLM ESP) which assesses potential interaction between the fishing industry and oil and gas development evaluated 5 ports in the New England area: Portland, Maine; Davisville, Rhode Island; and Boston, Gloucester and New Bedford, Massachusetts.

Deepwater access is readily available to each port via channels maintained by the Army Corp of Engineers. All ports except Davisville have significant freight activity in addition to an extensive fishing fleet. A significant portion of congestion is related to pleasure craft. Otter-trawl fishing vessels receive berthing from fish houses, fuel facilities and maintenance yards. Berthing at times (e.g. Christmas holidays, during storms) is of short supply but solved by several vessels rafting together.

The groundfish trawl and scallop fleets in New England have expanded by about 50% since the enactment of the 200 mile limit four years ago. This rapid expansion has affected all ports except Davisville, which has a relatively small fishing industry. All ports except Davisville are heavily dependent on species such as cod, flounder, and whiting. The groundfish fleet is regional in that it concentrates fishing activity in the Georges Bank region. Trips generally last one week with several days in port for crew rest, unloading of catch and maintenance. Each port also has small scale operators which typically pull lobster pots in addition to operating in bluefin tuna, swordfish, and gill net fisheries. Ports, except Davisville, have several other seasonal fisheries of minor importance: purse seining for non-food fish, long-lining for swordfish, and landing of scallops by Virginia and North Carolina vessels.

Repair facilities for commercial fishing vessels are extensive in both Gloucester and New Bedford. The only repair yards which could accommodate OCS crew and supply vessels are located in Fairhaven (New Bedford area) and Boston. Larger vessels would have to go to Boston and would be serviced in yards which are too large to service fishing vessels economically.

Congestion is extensive in all study ports except Davisville. Congestion is not of a magnitude which causes great delays or perceptible effects on operating efficiency.

Of the ports studied only Gloucester has no viable sites suitable for OCS staging areas. Although waterfront property is at a premium, New Bedford, Boston, and Portland have numerous areas which could easily accommodate considerable development with minimal costs and impacts. Davisville already hosts extensive staging sites and additional room is easily available with minimal or marginal impacts. A peak of 87 OCS service vessels is expected by 1995 which is within the capacity of Davisville to handle. Therefore, impacts on the major New England fishing ports from OCS development is not expected.

Conclusion: Some of the commercial industry may be impacted as a result of the proposed Sale. A possible oil spill could have a serious impact on specific fishing stocks and thus on commercial fishery income if the spill coincided with a species spawning and a poor-year class.

CUMULATIVE IMPACTS

Operations related to proposed Sale No. 52 are assumed to include 17 exploration wells, 26 delineation wells, and 473 development wells over the life of the field. In addition, Sale No.42-related operations are assumed to include 10 exploration wells, 5 delineation wells, and 78 development wells. OSTAM predicts one major spill greater than 1,000 barrels could occur as a result of Sale No. 42 operations. Operations from both would result in cumulative impacts on commercial fisheries due to oil spills and chronic discharges from drilling vessels, platforms and transport vessels.

It has been estimated that approximately 236,000 tons of drilling muds and 738,000 tons of cuttings will be discharged as a result of Sale No. 42. Discharges from proposed Sale No. 52 are expected to be 11,601,962 barrels of drilling muds and 1,840,651 barrels of drilling cuttings. The discharge will result in the burial of benthic organisms, such as the commercially important sea scallop and surf clam. This would render some areas of the surf clam and scallop fisheries in the immediate vicinity of drilling operation temporarily unfit for commercial harvesting.

An estimated 13 oil spills greater than 1,000 barrels are expected to occur from proposed Sale No. 59 and existing OCS lease sales in the adjacent Mid-Atlantic region. Oil spills in the Mid-Atlantic are not expected to have any effect on the commercial fisheries on Georges Bank (compare Tables 10 and 16, OSTAM, Appendix D).

Ninty-three oil tanker spills greater than 1,000 barrels are expected over a 30-year period from existing oil imports in the North and Mid-Atlantic. OCS oil is expected to backout some of this foreign oil, thereby reducing the number of spills from existing tankers. The majority of oil tanker spills occur during loading and offloading operations or when navigating in restricted waterways. None of the tracts tentatively selected lies with a Traffic Separation Scheme, a Precautionary Area, or the Nantucket Shoals area (see Visual No. 1).

Overall cumulative impacts on commercial fisheries from Sale No. 42 and the proposed action would come primarily from the proposed Sale due to the large size of the sale area, greater resources estimates (see Section I.A.1), and projected number of oil spills expected.

Conclusion: The amount of fishing space lost to rigs and platforms will increase due to the proposed Sale. The cumulative effect of discharging drill cuttings and muds would be additive but is not expected to have a significant impact. OCS oil is expected to replace imported oil so possible impacts due to an oil spill should not substantially increase. A possible oil spill could have a serious impact on specific fish stocks and, thus on commercial fish income if the timing was coincidental with a species spawning and a poor year class. There could be some decline to the commercial fisheries due to these cumulative OCS and existing tanker activities.

ALTERNATIVE 2: DELAY THE SALE

Delaying the proposed Sale may not decrease the risk of an oil spill affecting the commercial fisheries on Georges Bank. Imported oil will continue to pose a threat to these fishing activities. Potential impacts outlined under Alternative 1 would not significantly be changed or reduced by delaying the Sale.

Ongoing studies could produce information useful in developing biological stipulations, invoking existing lease stipulations, developing regional operating orders,and other mitigating measures more specifically designed to the proposed Sale. Therefore, production of oil and gas resources could be advantageously exploited while providing maximum protection to the commercial fisheries on Georges Bank.

Conclusion: To delay the proposed Sale would postpone possible impacts to the commercial fisheries on Georges Bank, not prevent them.

ALTERNATIVE 3: CANCEL THE SALE

To cancel the proposed Sale would eliminate any chance of an oil spill occurring and impacting the commercial fisheries on Georges Bank from OCS proposed Sale No. 52 oil and gas activities. Because exploration and subsequent development are scheduled for Sale No. 42, all impacts to commercial fisheries due to OCS development would not be completely eliminated. Imported oil and domestic oil from other regions would continue to be tankered through the North Atlantic, posing a threat to the commercial fisheries on Georges Bank and continuing the existing level of potential impact in the region.

Conclusion: Cancellation of the proposed Sale would significantly reduce the risk of OCS oil and gas activities from adversely impacting the commercial fisheries on Georges Bank. Imported oil would continue to pose a threat to the commercial fisheries in the area.

ALTERNATIVE 4: DELETE 49 TRACTS IN WATER DEPTHS GREATER THAN 2000 METERS

Deletion of 49 tracts in water depths greater than 2000 meters constitutes only a 9 percent reduction in the proposed Sale area. No important spawning grounds are located in this proposed deleted area. The major spawning grounds are located on Georges Bank in water depths less than 200 meters (see Visual No. 5). Little if any commercial fishing takes place in water depths greater than 2000 meters within the proposed Sale area. The effect on commercial fisheries would not be substantially reduced from that described under Alternative 1.

Conclusion: The impact to fishery resources under this alternative would be similar to Alternative 1.

ALTERNATIVE 5: DELETE 205 TRACTS TO PROTECT FISHERIES AND OTHER BIOLOGICAL RESOURCES

Deletion of 205 tracts or 36 percent of the proposed Sale area would leave 335 tracts in deeper water under this alternative.

Under this alternative, 69 fewer production wells and 7 fewer platforms would be expected, with 248,262 less barrels of drilling muds being discharged in the proposed Sale shelf area. The majority of expected impacts from chronic discharges discussed under Alternative 1 would be eliminated on the continental shelf because the 335 tracts left are in deeper water on the continental slope and rise. Lobsters are found virtually on all parts of Georges Bank, with highest concentrations in the canyon heads along the southern tier. Thirty-three of these 205 tracts are located at the heads of canyons within the proposed Sale area. This alternative would protect commercially important lobster and tilefish within the canyon environments.

Table I.V.9.1 shows the range of area loss, catch loss, and associated dollar loss from spacial exclusion over various levels of OCS development from the proposed Sale. Because the vast majority of the commercial fisheries in the proposed Sale area are located along the shelf and shelf break (see Visual No. 5), these impacts from spacial exclusion would be virtually eliminated.

The physical oceanographic conditions of the Georges Bank crest are believed to lead to the retention of fish eggs and larvae on which the commercial fishing industry on Georges Bank depends. Any oil spill impacting this area during spawning could have a significant impact on that particular commercial fishery. Under this alternative, the probabilities of an oil spill occurring and impacting the Georges Bank crest over a 30-year period is 59% as opposed to 75% under Alternaitve 1. Also, with 69 fewer production wells and 7 fewer platforms in the shelf region, chronic discharges onto the shelf region would be virtually eliminated.

Conclusion: Deletion of these 205 tracts would greatly reduce the potential impact on the commercial fisheries on Georges Bank within the 200 meter isobath and in canyon heads.

ALTERNATIVE 6: DELETE 33 TRACTS IN CANYON HEADS

Canyon heads were an area of concern during Sale No. 42 and the scoping process for the proposed Sale because they are commercially important areas for lobster and tilefish. Lobster are found on virtually all parts of Georges Bank, with highest concentrations in the canyons heads along the southern tier. Deletion of these 33 tracts would protect the heads of Veatch, Hydrographer, Welker, Oceanographer, Gilbert, Lydonia, and Powell canyons from OCS activities.

Hecker *et. al*. (1980, BLM ESP) noted faunal densities in canyons higher than on the continental slope, suggesting that this is probably a consequence of higher nutrient flux and greater substrate variability. Increased suspended sediments due to drilling muds and cuttings could alter the habitat within the canyon environments on which lobster depend. This alternative would also protect tilefish populations within the canyon environments.

Conclusion: Deletion of these 33 tracts would virtually eliminate direct impacts to commercially important populations of lobster and tilefish within the canyons in the proposed Sale area.

ALTERNATIVE 7: GEORGES BANK AS A MARINE SANCTUARY

Three major restrictions are considered for oil and gas activities within the marine sanctuary: 1) the barging of drilling muds and cuttings from the heads of canyons, 2) discharging under NPDES permit requirements for Sale No. 42 and, 3) pipelining of oil to a moored buoy outside the sanctuary.

The barging of drilling muds and cuttings would be required near seven canyon heads within the proposed Sale area. Thirty-three tracts lie at or near the heads of Powell, Lydonia, Hydrographer, Oceanographer, Welker, Gilbert, and Veatch canyons in water depths from 160 meters to 825 meters (see Figure II.B.6-1). These are commercially important areas for lobster and tilefish resources and possible impact from drilling muds and cuttings would be virtually eliminated.

Controlling discharges in the 205 tracts of the proposed Sale that are within the sanctuary boundary as required under EPA NPDES permits for Sale No. 42 on Georges Bank; these restrictions require that discharges do not exceed a maximum rate of 30 barrels per hour, be pre-mixed with seawater at a 10:1 ratio, and discharged at a depth greater than 10 meters. The objective is to dilute the discharge prior to entering the water column, eliminate bulk drilling-mud dumps, and keep the discharge below the depth of maximum concentration of fish eggs and larvae on which the commercial fisheries depend. This would greatly decrease possible impacts to ichthyoplankton, and ultimately to the commercial fisheries on Georges Bank from drill muds and cuttings.

Conclusion: A marine sanctuary with restrictions on discharging and transport during oil and gas development would significantly reduce the potential impacts to the commercial fisheries on Georges Bank.

ALTERNATIVE 8: MODIFY THE PROPOSAL BY DELETING 94 TRACTS CONTAINING POSSIBLE SEDIMENT SLUMPS

Impacts to commercial fisheries under this alternative would be slightly reduced due to the decrease in size (approximately 18%) of the proposed Sale area. The major commercial trawling grounds are located on Georges Bank in water depths less than 200 m (see Visual No. 5). All of the tracts to be deleted under Alternative 8 are located on the continental slope away from the most important fishing area on the continental shelf of Georges Bank and deeper than 200 m. Therefore, any impact on commercial fisheries would be slightly less than Alternative 1.

Conclusion: Impact to commercial fisheries would be slightly less than Alternative 1.

10. Impacts on Vessel Traffic

Alternative 1: Hold the Sale as Proposed

The major impacts to shipping and navigation that could be expected to occur would stem from the siting of structures on the OCS. Proposed Sale No. 52, in the mean case, is projected to result in 20 production platforms and 31 subsea production complexes. Navigational or operational errors in the vicinity of these facilities could result in collisions. Impacts which could result from any such collisions include injury, loss of life, spillage of oil and release of debris, including all or part of a rig, platform, or ship. The release of a ship's cargo could present a serious threat to the environment if the cargo were a toxic chemical, crude oil, or refined petroleum product. Floating trash accidentally lost off platforms would also constitute a hazard to boats. Damaging collisions could result between small boats and floating debris.

The proposed lease area is in an area of high traffic density. However, none of the tracts tentatively selected lies within a Traffic Separation Scheme, a Precautionary Area, or the Nantucket Shoals Area to be Avoided (see Visual No. 1). Therefore, interference with vessel movements within these routing systems will not occur as a result of the proposed sale.

Supply boats servicing rigs and platforms will result in an increase in ship traffic in area harbors, particularly Narragansett Bay, and the offshore area. A peak of 52 supply boats is projected to be required to service rigs and platforms. From the Davisville support base site the round trip will average 4-500 miles. When supply boats are approaching or leaving the harbor areas around the assumed sites of the operations support bases, Davisville, RI, and Stapleton on Staten Island, NY, they will approach and leave via existing Traffic Separation Schemes (TSSs). Very little navigational interference can be expected between ships utilizing established TSSs. However, further offshore, when ships are outside the TSSs, there is a potential for collisions with structures on the OCS, particularly at night and during fog or heavy sea conditions.

Visibility reduction due to fog is most prevalent during May, June, and July. During this period, fog and haze may reduce visibility to less than 2 miles 25 percent of the time. While reduced visibility has the potential of increasing the number of collisions between vessels and offshore structures, rigs and platforms could also provide a benefit for safe navigation due to their distinct marking and color, lighting, fog horns, radar, and other navigational aids.

Although different weather and sea conditions occur in the Gulf of Mexico and the North Atlantic leasing regions, both are areas of high shipping traffic intensity. There are about 2500 structures in the U.S. Gulf of Mexico. Yet, the number of collisions of commercial vessels with platforms is quite low. Since 1960 only six such accidents have been recorded (U.S. DOI, GS, 1980).

Slow moving vessels engaged in trenching and pipelaying activities would also be operating in the area during the development phase. In the mean case, proposed Sale No. 52 is projected to result in two pipelines to transport natural gas to shore. They are assumed to landfall on the Rhode Island coast. Pipeline construction operations, which would involve a lay barge, tugboats, and pipe supply vessels, would terminate once the pipelines were laid. Therefore, impacts to navigation would be limited to the time required to lay the pipeline, and prior knowledge of the precise location of the pipelaying operations at a given time would enable other vessels to avoid this work. Information of this type would appear in the local Coast Guard District's Notice to Mariners.

The largest tanker likely to be used to transport sale-related crude oil is 65,000 dwt (deadweight tons). These tankers would load at production facilities and then proceed to Mid-Atlantic refineries, approaching via established Traffic Separation Schemes. Since the oil they would be carrying is assumed to replace imported oil for the most part, they will not be adding significantly to the tanker traffic within these Traffic Separation Schemes. It is only when these tankers are loading at production facilities within the proposed lease area that they will present additional hazards to navigation. However, the fact that all proposed lease blocks lie outside of established Traffic Separation Schemes means that tankers will be loading outside of them also, and all the measures available to mitigate potential hazards to navigation caused by the presence of production facilities will apply equally to the loading tankers.

Existing measures to mitigate adverse impacts to navigation include: 1) OCS Operating Order No. 1, administered by USGS, which covers the identification of wells, platforms, structures, mobile drilling units, and subsea objects; 2) the requirement to obtain a permit from the Army Corps of Engineers for an offshore structure having an impact on navigation; 3) the requirement to obtain a permit from the Coast Guard for lights and fog signals on offshore structures to prevent their being

a hazard to marine navigation; and 4) the Coast Guard's authority to establish safety zones around structures for the purposes of navigational safety. Stipulation No. 6 is a proposed sale-specific mitigating measure which would require that personnel involved in vessel operations, and platform and shorebased supervisors be required to complete a training program in fishing industry operations.

Conclusion: The impacts on vessel traffic resulting from the proposed sale would be due to the potential for collisions caused by the siting of structures on the OCS. However, sufficient measures exist to mitigate the likelihood of such collisions, so that if the sale is held as proposed, it is likely to result in only minimal impacts on safe navigation.

CUMULATIVE IMPACTS

Other OCS sales would increase the number of production facilities expected. As a result of Sale No. 42, there are 6 production platforms projected, 7 from Sales 40 and 49, and 26 from proposed Sale No. 59. No subsea complexes are projected as a result of Sale No. 42, and comparable information does not exist for the Mid-Atlantic sales. Any production facilities needed would probably be spread over a very wide area of the open ocean and none would be in established Traffic Separation Schemes. Therefore, considering the minimal impact to safe navigation in the Gulf of Mexico with approximately 2500 structures and boats servicing them, it is unlikely that safe navigation in the North and Mid-Atlantic will be seriously adversely impacted in the cumulative case.

Conclusion: The additional offshore facilities in the cumulative case would not significantly increase the chance of collisions. Potential impacts to state navigation would remain minimal.

Alternative 2: Delay the Sale

Delaying the sale would not change any of the potential impacts to vessel traffic projected under Alternative 1.

Conclusion: The impacts to vessel traffic would be the same as under Alternative 1.

Alternative 3: Cancel the Sale

All potential conflicts with navigation that are projected to result from proposed Sale No. 52 would be eliminated under this Alternative. However, some could occur from possible development and production activities in the North Atlantic as a result of Sale No. 42, and in the Mid-Atlantic as a result of Sales 40/49 and proposed Sale No. 59. Existing mitigating measures would be adequate to minimize the risks, however.

Conclusion: Cancelling the sale would eliminate those potential adverse impacts to navigation due to proposed Sale No. 52 alone, but not all such potential impacts in the North and Mid-Atlantic leasing regions, due to other sales having taken place which could result in the emplacement of offshore structures which would pose a minimal risk of collisions.

Alternatives 4, 5, 6, and 8: Deletion Options

Under Alternative 4, 18 production platforms are projected, and under Alternative 5, 13 are projected, instead of the 20 projected under Alternative 1. In addition, 21 subsea production complexes are projected under Alternative 4 and 31 under Alternative 5. Numbers of production facilities have not been projected for Alternatives 6 and 8. However, even though there might be slightly fewer production facilities under any of these Alternatives than under Alternative 1, the potential numbers are still quite small when compared to the number of structures in the Gulf of Mexico, where there are about 2500 structures, which are not considered a major hazard to navigation.

Under any of these deletion Alternatives, none of the production facilities would be located in a Traffic Separation Scheme, since no tracts potentially offered are in a Traffic Separation Scheme. Sufficient measures exist for permitting exploration and production facilities to ensure that they do not present hazards to safe navigation.

Conclusion: The major impacts to navigation that would be expected to occur as a result of any of these deletion alternatives would stem from the siting of structures on the OCS and the resulting potential for collisions. However, impacts are expected to be minimal.

Alternative 7: Marine Sanctuary Proposals

The regulations implementing the marine sanctuary program specify that it will be conducted in close cooperation with other related programs, including the regulatory and enforcement programs of the U.S. Coast Guard (15 CFR 922.1 (e)). Therefore, potential impacts on vessel traffic would be examined during the process of review leading to the designation of any marine sanctuary.

Tanker traffic across a marine sanctuary could be regulated, and discharges from ships could be prohibited in an area designated as a marine sanctuary, depending on the resources being protected and the specific regulations adopted for a specific marine sanctuary.

A marine sanctuary proposal that could have a major impact on vessel traffic would be if the whole Georges Bank area were designated. In that case, some provision would have to be made for vessel traffic to cross the area in order for ships to enter and leave the Boston Harbor and Nantucket-Ambrose Traffic Separation Schemes.

If a marine sanctuary were established for Nantucket Sound, activities from the proposed sale relating to tanker traffic would be unaffected, since there would be no reason for tankers carrying OCS-produced oil to transit the waters of Nantucket Sound. After loading at a production platform, the tankers would proceed directly to refineries in the Mid-Atlantic via established Traffic Separation Schemes.

Conclusion: Since the impacts on vessel traffic would have to be considered in any proposal to designate a marine sanctuary, it is unlikely that any such designation would have a negative impact on navigation in the North Atlantic leasing region.

11. Conflicts with Land Use Plans and Policies

Alternative 1: Hold the Sale as Proposed

The most likely scenario used for analyzing the impacts associated with proposed Sale No. 52 was developed after considering the policies and constraints embodied in numerous applicable regional, State and local land use plans. This section will identify those policies and discuss any conflicts that exist between the policies and the proposed Sale No. 52 development scenario under the conditional mean case of oil and gas development. (For an analysis of the impact producing factors associated with potential onshore facilities see Section IV.A.2.)

The identified location of all facilities discussed in this section are hypothetical. They do not represent what will definitely occur if this proposed sale is held, but what may occur. Locations are assumed in order to assess the various types of impacts which could occur if the proposed Sale is held. The assumptions behind choosing these locations are explained in Appendix C.

Operations Support Bases

Two operations support bases which are assumed to be expanded or constructed during the development phase of this proposed sale are located in Davisville, Rhode Island and the other in Staten Island, New York. Davisville presently has 1564 developable acres, of which 450 have been slated for oil-related development. Two existing 1200 foot piers north of an airfield may be used for berthing space for the petroleum support industries. For future OCS activity, the area south of this could be filled in to form a 4000 foot long bulkhead to accommodate larger vessels. The carrier pier south of the airfield could provide fuel support services for vessels servicing offshore rigs. (Rhode Island Department of Economic Development, 1977). Currently, the supply boats out of Davisville are servicing exploratory drilling being conducted in the Sale No. 42 lease blocks. A multi-agency Task Force (including representatives from the Rhode Island Coastal Resources Management Council, Governor's Energy Office, Department of Transportation, Navy, Federal Aviation Administration and the town of North Kingstown) concluded that operations support activities at Davisville would be an acceptable use.

Facilities at the Stapleton Piers on Staten Island (just north of the Verrazano Narrows Bridge) were identified by the Port Authority of New York and New Jersey as being a possible site for an OCS operations base. Existing deteriorating piers at this site would have to be removed, leaving approximately 4000 linear feet of shoreline bulkhead, with water depths of 18-35 feet at MLW. The site is currently zoned as "Manufacturing Three" and an operations base there would be compatible with New York City's Zoning Resolution. The immediate area is currently characterized by industrial uses. New York City is encouraging the development of this site as a support base as part of the City's marketing program. This site also complies with the New York State coastal zone management policy (Policy 8.4) on siting OCS operations facilities.

Conclusion: Both operations support bases assumed to be constructed as a result of this sale should not pose any major conflicts with existing land use plans and policies.

Pipelines And Pipeline Terminals

Two 36 inch gas pipelines are assumed to be constructed as a result of the proposed sale, one 130 mile line, and a second 220 mile line. The scenario calls for both to come ashore in Little Compton, Rhode Island and travel approximately 25 additional miles to a gas processing plant assumed to be located in Fall River, Massachusetts. (See Figure II.B.1.a-2)

The two pipelines could be necessary and may be constructed almost simultaneously. If this is done a 65-80 foot right-of-way would be required. (Normally a 50 foot right of way is required but if two onshore pipelines are laid at the same time they must be spaced 50 feet apart. An additional 15-30 feet would be necessary during the construction phase for pipelaying equipment). In addition, each pipeline could require an offshore gas compression station, located on a fixed platform. The exact number of compression stations will be determined by the pressure of the gas at the wellhead.

Under the Natural Gas Act (15 USC 717), any pipeline transporting natural gas must obtain, prior to construction, a Certificate of Public Convenience and Necessity from the Federal Energy Regulatory Commission (FERC). FERC can also prepare an environmental report and hold public hearings on a proposed right-of-way prior to granting its approval.

The State of Rhode Island regulates pipeline siting through the Coastal Resources Management Council, and necessary permits must be obtained from the Council, the State Public Utilities Commission and from each municipality that the pipeline crosses. Council policies on gas pipelines are listed under Sections 610.2-2 and 630.2-2 on the State's Coastal Zone Management Program. Authorities of the Public Utilities Commission (PUC) are listed under Title 31 of Rhode Island's general laws. Parties aggrieved by decisions or orders of a municipal zoning board may appeal to the PUC

within 10 days under Title 39-1-30. The State will generally approve the siting of a pipeline provided that:

1. There is a need for the proposed pipeline;
2. Impacts on public service requirements and in-state employment opportunities have been identified and considered;
3. Construction and/or operation will be in conformance with all applicable environmental standards, guidelines and objectives;
4. Siting will not cause secondary developments that are inconsistent with the State Guide Plan or approved municipal master plans.

A small segment of the gas pipeline is also assumed to cross into the Fall River area of Massachusetts. The Massachusetts Energy Facilities Siting Council (EFSC) has been designated as the principal State agency responsible for reviewing energy plans and sites. (See M.G.L.A.c.164 s.691). The following general factors would be considered by the Council prior to granting approval of a pipeline right-of-way.

1. The impact of the pipeline corridor's construction and maintenance;
2. Risks to public safety, including the potential magnitude of danger and size of populations affected;
3. The environmental impacts of potential spills, leaks, and ruptures of pipelines.

Various other state agencies have regulatory responsibilities over specific resources such as air, water, ocean sanctuaries, wetlands protection, and tidelands. Local regulatory agencies have the responsibility to review the site and facility for conformance with local zoning. The Energy Facilities Siting Council also retains the power to grant relief from local zoning restrictions under M.G.L.A. c.164 s.69K.

Conclusion: While there may be some conflicts in acquiring certain tracts of land for the pipeline right-of-way, it does not appear that the pipeline landfall and onshore route are contrary to the PUC's and EFSC's general siting standards.

Pipecoating Facility

The Bredero Price Company operates a pipecoating facility at Fairless Hills, Pennsylvania. Their use of the impingement process for coating pipe (a process required for offshore pipelines) makes this site a potential choice for these operations for proposed Sale No. 52. This facility is part of an existing industrial park and has available adjacent land if expansion is required.

Conclusion: There are no known land use conflicts associated with constructing (or expanding) the pipecoating facilities at this site.

Gas Processing Plant

Proposed Sale No. 52 may result in the construction of one gas processing plant to remove any impurities which may be present. The two gas pipelines described earlier would terminate at this facility, which (for the purpose of this analysis) is assumed to be located in Fall River, Massachusetts. The site to process the 1.42 BCF/D anticipated as a result of this sale may require 96 acres of land (including a buffer area). This facility could be sited within or adjacent to the proposed 3,800 acre New England Energy Park, which is located east of downtown Fall River. The site has been zoned for heavy industry, can be adequately buffered, and has the necessary infrastructure to accomodate a gas plant. State permits and approval would be required from the Energy Facilities Siting Council, State Fire Marshall (M.G.L.A. c.148 s. 13), Department of Public Utilities (M.G.L.A. c.25 s.1214), and the Commissioner of Public Safety (M.G.L.A. c.148 s.37).

Conclusion: A gas plant located at this site would be compatible with the development goals of Fall River and Southeastern Massachusetts.

Heliport

Helicopter service to the production platforms and drilling rigs resulting from the proposed sale is assumed to originate from the Barnstable Municipal Airport in Hyannis, Massachusetts. A maximum of 15 helicopters per day will be making use of this facility by 1995. A helipad would need to be constructed, but room is available for this expansion if required.

Conclusion: The siting of a heliport at the Barnstable Airport will not cause any major conflicts with existing land use plans and policies.

Cumulative Impacts

Sale No. 42 may result in the construction of a 20 inch diameter gas pipeline which may come ashore on Little Compton, Rhode Island. This pipeline, is assumed to be constructed in 1990 (3 years before the two Sale No. 52 pipelines) and may terminate at a 42 acre (.162 BCF/D) gas processing plant assumed to be located in Bristol County, Massachusetts.
Oil from Sale No. 42 is also assumed to be tankered to existing refineries in Middlesex County, New Jersey where it could replace imported crude.

The cumulative impacts of proposed Sale No. 52 with Sale No. 42 could be the addition of a 96 acre gas processing facility and an approximately 25 mile 65-80 foot pipeline right-of-way (for the two gas pipelines) to the Sale No. 42 facilities described above. While specific sites have not been selected for the Sale No. 42 facilities, it can be assumed that the permitting requirements previously noted will have to be followed, as the types of facilities to be constructed are similar.

A gas processing plant, if constructed in Fall River, may increase the impacts associated with other non-OCS energy facilities that have either been proposed or are under construction in the area. Construction of a 600 acre coal gasification plant at the New England Energy Park may begin as early as 1984. Financed by EG&G, this plant will employ some 5,000 employees during construction and 1000 during plant operation. Also, a coal conversion plant is under construction in Somerset, (approximately 6 miles west of the New England Energy Park) with completion scheduled for late 1981. Employment at the 80 acre site will range from 500-1000 employees.

These and other smaller energy related facilities in the area could add to the impacts caused by the proposed sale. Water demands in the region would increase, along with possible increases in effluents discharged into the atmosphere. (See Section IV.A.4)

Alternative 2: Delay the Sale

A delay in holding this sale until information on the impacts of Sale No. 42 are available would give North Atlantic states additional time to plan for any associated onshore impacts. To a large degree, state funded studies of this nature are dependent upon receiving Federal Coastal Energy Impact Program funds (Section 308 of the Coastal Zone Management Act of 1972, as amended). The allocation of these funds is partially based upon the number of times a state is "affected" by OCS lease sales under the OCS planning schedule (15 CFR 931.141). However, continued funding of the CEIP is not assured.

Conclusion: Delaying the sale would have no significant effect on land use in the region.

Alternative 3: Cancel the Sale

Cancelling the sale would eliminate any potential land use conflicts which could result from Alternative 1, but not all conflicts stemming from the siting of OCS-related facilities in the North-Atlantic. Several facilities projected to be needed as a result of Sale No. 42 could conflict with existing land use plans or policies. Any such conflicts resulting from Sale No. 42 are noted under Cumulative Impacts.

Conclusion: Any potential land use conflict which are a result of this proposed sale would be eliminated.

Alternative 4: Delete Tracts in Water Depths Greater than 2000 Meters

Since this alternative would remove only 47 tracts or 9% of the proposed sale area, the level of activity needed for support and the amount of recoverable hydrocarbons would be somewhat reduced. Therefore the size of the gas processing plant could also be slightly reduced and some potential land use conflicts could be avoided.

Conclusion: This alternative would reduce any land use conflict caused by this sale.

Alternative 5: Modify the Proposal by Deleting Tracts to Protect Fisheries

Alternative 6: Modify the Proposal by Deleting Tracts in Canyons Heads

Alternative 8: Delete Tracts Containing Possible Sediment Slumps

Each of these three alternatives would remove from 33 to 205 tracts of the proposed sale area from consideration. Alternative 5 involves 205 tracts (37.9%) of the sale area, alternative 6-33 tracts (6.1%) and alternative 8-94 tracts. Removal of this number of tracts under any of these alternatives could reduce the level of activity needed for support and the amount of recoverable hydrocarbons. The size and possibly number of onshore facilities required could also be reduced.

Conclusion: Any potential land use conflict created under Alternative No. 1 could be reduced.

Alternative 7: A Georges Bank Marine Sanctuary

N/A

12. Impacts on Coastal Recreation and Tourism

Alternative 1: The Proposal

Coastal recreation and open space areas could be affected as a result of the proposed sale by facility construction or by oil spills which reach shore.

Of the facilities that could result from the proposed sale, only the two projected gas pipeline landfalls and rights-of-way are likely to compete for land used or suitable for recreation purposes. The assumed landfalls of the two natural gas pipelines are along the south shore of Little Compton in southeastern Rhode Island. Little Compton is a rural, seashore town in Newport County. As long as construction is timed for an off-peak season for recreational use, and the site is restored to its previous condition, there should be no conflict between the landfall or right-of-way and the potential or actual recreational use of the land.

Recreational beaches in other areas have been used as sites for landfalls of pipelines. For example, in 1967, Transco constructed a natural gas pipeline connecting New Jersey and Long Island with the eastern landfall at Long Beach, New York. Long Beach is a sandy, heavily used recreational beach on the southern shore of Long Island, about 15 miles from Manhattan.

Installation of the pipeline at Long Beach occurred during September, so that there would be no conflict with peak summer recreational use of the area.

The beach restoration was completed by the end of November and the beach was available for recreational use the following summer. The landfall remains virtually unchanged and indistinguishable from its surroundings (NERC, 1981).

The acquisition and construction of a pipeline right-of-way through eastern Rhode Island to its assumed terminus in Massachusetts offers the potential for these two states to acquire easements or identify sites suitable for linear recreational facilities such as hiking trails or bikeways. Such uses would be consistent with policies in each state's Statewide Comprehensive Outdoor Recreation Plan and Coastal Zone Management Program.

Prior to tract selection, many comments were received expressing the concern that no tracts be offered closer than 50 miles to shore. This is due to two main reasons: that offshore operations not be visible from shore, and that there be an adequate buffer zone to protect beaches and other coastal resources from any oil spills that may occur in the proposed lease area. The closest tract tentatively selected for proposed Sale No. 52 is 86 statute miles from shore. Therefore, no drilling operations will be visible from shore.

If an oil spill reached a beach area, the tourist economy of the area would be adversely affected. The extent of economic impact is extremely difficult to assess since the degree of impact depends on many variables that cannot be predicted in advance. These include the beaching location, the size and duration of the spill, the composition of the oil, the season in which it occurs, and the publicity that surrounds the occurrence. Beaches might have to be closed until clean-up was accomplished. Once cleaned up, use levels might not return to normal due to adverse publicity, although people will still use beaches when the water is polluted.

If oil were to beach during or just prior to the peak summer months, the greatest impact on beach use would probably occur. For example, about 8 million visits were made to Cape Cod during 1979 for recreation related purposes, and about 60% of these visits occurred during July and August. These visits resulted in $247 million in direct expenditures, of which amount about $127 million was spent during July and August (Cournoyer and Kindahl, 1980). Thus, it is likely that an oil spill which hit Cape Cod during or just prior to these peak summer months would have a greater adverse impact on beach use and tourist revenues than one which occurred during another season. An approximate loss cannot be predicted because it is unlikely that the whole Cape would be affected and, if parts were, the impact could be a shift in patterns of use and locations of expenditures rather than a total loss. The extent of existing tourist accommodations near non-impacted areas would limit the degree of shifting possible before overcrowding would occur.

The vulnerability of various coastal recreation areas to oil spills originating from the proposed sale area has been determined using the Oil Spill Trajectory Analysis Model. The conditional probabilities give the likelihood that if a spill has occurred at a certain point, it would be moved by winds and currents to contact a particular land segment. Assuming that a spill has occurred in the proposed Sale No. 52 lease area, it has, at the most, a 1% chance of contacting land within 30 days. The only land segments with this 1% chance are Nantucket and Martha's Vineyard. All other land segments have a less than 0.5% probability of being contacted (OSTA Model, Appendix D, Table 8).

When considering the transportation of the Sale No. 52 oil to shore, the risk of contacting land increases. Nantucket is the most likely land mass to be hit. Assuming that a spill has occurred, Nantucket faces a 12% chance of being contacted within 30 days by a spill originating from the closest segment of the tanker route assumed to be used by a tanker carrying OCS-produced oil (Appendix D, Table 8 and Figure 4). Additional coastal areas important for recreational uses are also at risk when considering the transportation of the proposed Sale No. 52 oil. For example, it is assumed that some of the Sale No. 52 oil will be tankered to Philadelphia area refineries via Delaware Bay. The probability that a spill starting from the last segment of this tanker route will hit nearby land segments within 30 days, assuming that a spill has occurred, ranges from 1 to 8%. Most of the Sale No. 52 oil is assumed to be tankered to refineries in northern New Jersey. The expected tanker route into New York Harbor puts beach areas on the south shore of Long Island and in northern New Jersey at risk. Probabilities range from 1% to 10% that nearby land segments may be contacted within 30 days (OSTA Model, Appendix D, Table 8). Thus, it is more likely that a recreation area will be impacted by a spill resulting from transportation of the oil than from one resulting from production in the proposed sale area.

Since the above probabilities were derived with the assumption that an oil spill has already occurred, they do not depend on the volume of oil expected to be produced. However, to get an assessment of the risk that this proposed sale poses to various resources, joint probabilities have also been derived. These factor in the amount of oil expected to be produced as a result of the proposed sale. The probability that over a 30-year assumed production life of the lease area, a spill greater than 1000 barrels will occur and, within 30 days, contact coastal recreation areas is 20% for Martha's Vineyard, and 25% for Nantucket. These are the two most vulnerable coastal recreation areas to oil spills resulting from production in the proposed Sale area (OSTA Model, Appendix D, Table 10). To put this risk in the proper perspective, one must also consider that there is only a 40% chance that oil exists in the lease area in economically recoverable quantities.

In order to estimate the economic impact of an oil spill which affected a beach area, an economic model has been developed by Wilman (1980) to quantify the components of the experience that a beach-oriented visit

provides. The concept behind the model is that in renting tourist accommodations, one is actually purchasing a bundle of attributes, which includes not only the value of the accommodations, but also the environmental services to which the purchaser gains access. These environmental services include proximity to beaches of varying qualities. By adjusting the variables related to beach cleanliness, it is possible to measure the changes caused by an oil spill which affects a limited section of shoreline. A spill that affects a large portion of the beaches in an area would cause too many changes that would be beyond the capability of the model to record.

This model was applied to a sample of vacation homes rented on Cape Cod during the 1977 season. The short run losses to two areas of Cape Cod were quantified to assess the impact of debris, such as an oil spill, polluting area beaches. For beaches in the Wellfleet area, the season loss for rented homes nearby is assumed to be between $6000 and $8000. The area surveyed is adjacent to part of the Cape Cod National Seashore which has an annual visitation of 4 to 5 million people. The model was also applied to a group of beaches in the Falmouth area within Buzzards Bay. The seasonal loss here would be between $8000 and $12,000.

This model and its application give a general idea of the economic losses that could occur if an oil spill were to impact similar areas. The particular areas surveyed do not face a significant risk from an oil spill resulting from OCS sales in the North Atlantic, however. Assuming that a spill has occurred, spills originating from the proposed lease area or already leased tracts have a less than 0.5% chance of contacting either the Wellfleet or Buzzards Bay areas. The tankering of North Atlantic OCS oil to Mid-Atlantic refineries brings it closer to the Buzzards Bay area so that it has up to a 2% probability of being contacted (OSTA Model, Appendix D, Table 8). However, oil spill containment equipment can effectively seal off a bay to protect it from a spill that has occurred outside its mouth.

These two areas face a significantly higher risk from existing tanker routes that bring oil closer than the routes expected to be used by tankers carrying OCS-produced oil. For example, Buzzards Bay face up to a 24% chance of being impacted within 30 days by a spill from an existing tanker route used to deliver petroleum products to Rhode Island. The northern Cape area, which includes Wellfleet, faces up to a 32% chance of being contacted within 30 days by a spill from a tanker en route to Boston or further north (OSTA Model, Appendix D, Table 8).

Another study on the economic impact of an oil spill in the region (Long Island State Park and Recreation Commission, 1977) is discussed at length in the FEIS for OCS Sale No. 42, p. 1013-1016. Briefly, this study concluded that "a medium-to-large oil spill occurring adjacent to Long Island

and within the Ambrose-Nantucket route, could possibly wash ashore Long Island beaches, resulting in losses to the regional economy of between $423,000 and $13.3 million per week" (p. 28).

The Oil Spill Model run shows that, assuming a spill has occurred, there is a 10% chance it will reach eastern Long Island and a 5% chance that it will contact western Long Island within 30 days (OSTA Model, Appendix D, Table 8) from the tanker route superimposed on the Nantucket-Ambrose sea lane. The Nantucket-Ambrose route is assumed to be used by tankers carrying OCS-produced oil from the proposed sale area to New York-New Jersey area refineries. However, this same risk applies to all tankers utilizing this route. This risk would most likely continue to exist with or without the proposed sale. In addition, eastern Long Island faces a 21% chance of being impacted by a spill within 30 days from an existing route used by tankers carrying petroleum products to Connecticut (OSTA Model, Appendix D, Table 8). This risk would remain with or without the proposed sale.

Title III of the OCS Lands Act Amendments of 1978 established an Offshore Oil Spill Pollution Fund. Through this fund, persons who sustain an economic loss as a consequence of oil pollution arising from OCS activities may be compensated. The regulations which implement this appear at 33 CFR 135 and 136; they are administered by the Coast Guard. Part 136 of the regulations sets forth the claims procedures. Thus, if proposed Sale No. 52 were to result in an oil spill that reached shore, owners and users of areas important for coastal recreation and tourism would have recourse to compensation under this Fund.

Conclusion: The greatest risk to coastal recreation resources from proposed Sale No. 52 is from oil spills. The areas with the highest probability of being impacted adversely are Nantucket, with a 25% chance, and Martha's Vineyard, with a 20% chance of being contacted within 30 days by a spill greater than 1000 barrels over the assumed 30-year production life of the leases resulting from the proposed Sale. Transportation of the oil presents a greater risk to coastal recreation than drilling and production, with the greatest risk from transportation occurring along coastal recreation areas on Long Island, as well as those on Nantucket and Martha's Vineyard. The extent of impact would depend on the time of year the spill occurred, the amount reaching shore, the method of cleanup, and the effects of adverse publicity on user preference.

Construction of natural gas pipelines through beach recreation areas should have only short-term impacts as long as construction is timed for the off-season and the affected areas are restored.

Cumulative Impacts

Facility construction from activities other than OCS oil and gas exploration and development could compete with land used or suitable for coastal recreation in the region, thus reducing the supply of a finite resource.

However, this is not likely. In developing a Coastal Zone Management Program, states are required to identify coastally dependent uses and to establish a regulatory framework which will ensure that coastal land resources are not used inappropriately. Other policies deal with increasing access to coastal recreation areas.

If an additional gas pipeline landfall is required in the North Atlantic as a result of proposed Sale No. 42, it would not be expected to result in any conflict with recreational use at the landfall site as long as construction is timed for the off-season. Neither would those natural gas pipeline landfalls in the Mid-Atlantic projected as a result of Sales 40/49 and proposed Sale No. 59. However, the oil pipeline projected to result from Sale 59 would place parts of New Jersey near its assumed landfall under risk of being impacted by an oil spill.

Considering Sale No. 42 in addition to proposed Sale No. 52 increases the probability that Martha's Vineyard and Nantucket will be contacted after 30 days by a spill greater than 1000 barrels originating in the proposed sale area, to 22% and 28% respectively, over a 30-year period. This is in contrast to 20% and 25% when considering proposed Sale No. 52 alone (OSTA Model, Appendix D, Table 10). Most other land segments that register a hit show a slight increase in percent probability of being impacted.

Existing tanker traffic of crude oil and refined products poses a much higher risk, however. For example, Martha's Vineyard would then face up to a 52% risk and Nantucket a 66% risk over a 30-year period, of being impacted by a spill greater than 1000 barrels within 30 days (OSTA Model, Appendix D, Table B-2).

Conclusion: Oil spills from prior OCS lease sales and tankering of crude oil and refined products in the region greatly increase the risk of adverse impact to coastal recreation areas over that due to the proposed sale alone.

Alternative 2: Delay the Sale

Delaying the sale for any reason, including delay to assess the results of drilling on Sale No. 42 leases, would not change the impacts to coastal recreational areas; it would just delay them.

Conclusion: Delaying the sale would not change any of the impacts to coastal recreation areas expected under Alternative 1.

Alternative 3: Cancel the Sale

If the sale were to be cancelled, recreation resources in the North Atlantic would still face some risk of an oil spill due to potential production from Sale No. 42. The area with the highest probability of being impacted from

a spill greater than 1000 barrels within 30 days from a Sale No. 42 tract is Nantucket, with a 3% chance of being hit over a 30 year period (OSTA Model, Table 16).

There is a significant amount of tankering of crude oil and refined products in and through the North Atlantic region, and this would continue to pose a threat to coastal recreation areas. For example, the part of Cape Cod which contains the Cape Cod National Seashore has a less than 0.5% chance of being impacted by a spill from the proposed sale area considered alone, assuming that a spill has occurred, but has probabilities ranging up to 32% of being contacted from a spill occurring along parts of existing tanker routes (OSTA Model, Table 8). This is due to transportation routes currently used by tanker traffic bringing the oil into closer proximity to the Cape Cod National Seashore and environs. This tanker traffic will continue even if the sale is cancelled, and thus, many coastal recreation areas will continue to be vulnerable to oil spills.

Conclusion: Cancelling the sale would not eliminate the risk of coastal recreation areas being impacted by oil spills from tanker traffic.

Alternatives 4, 5, 6, 8: Deletion Options

Under Alternative 4, impacts to coastal recreation resources would be similar to those described under Alternative 1. The probability that over a 30-year period a spill greater than 1000 barrels would occur in the proposed sale area and contact Nantucket within 30 days is the same under Alternatives 1 and 4 - 25%. The similar probability for Martha's Vineyard is 20% under Alternative 1, and 21% under Alternative 4 (OSTA Model, Table 14).

Under Alternative 5, the probability for Martha's Vineyard is 19% and for Nantucket 23% (OSTA Model, Table 14), so both islands have a somewhat reduced chance of being contacted within 30 days by a spill greater than 1000 barrels over a 30-year period from the Alternative 5 proposed sale area, than from that under Alternative 1. This is probably due to the potentially deleted tracts being those closest to these land masses.

For Alternatives 6 and 8, there are no resource estimates or OSTA Model runs available, but based on those for Alternatives 4 and 5, it is unlikely that there would be a significantly different level of expected impact to coastal recreation resources than projected under Alternative 1.

Conclusion: The impacts to coastal recreation resources under any of these deletion alternatives would be similar to those projected under Alternative 1, and these would be caused by oil spills reaching shore.

Alternative 7: Consideration of Marine Sanctuaries

Designation of part or all of Georges Bank as a marine sanctuary should not affect the potential impacts to coastal recreation and tourism that were projected under Alternative 1. These would be short-term impacts from pipeline construction and potential adverse impacts from oil spills which reach shore.

If an area such as the central area of Nantucket Sound were made a marine sanctuary, the impacts to coastal recreation projected to occur as a result of the proposed sale would not be changed, because no activities resulting from the proposed sale would be affected.

Conclusion: The designation of part of all of Georges Bank or Nantucket Sound as a marine sanctuary would not affect the potential impacts to coastal recreation and tourism that are projected as a result of the proposed sale and discussed under Alternative 1.

13. Socio-Economic Impacts

Oil and gas development, like any new industrial development, may result in short and long-term changes in the economics and demographics of an area. These changes (i.e. increases in employment, population, and income) can be a stimuli to an area experiencing economic decline and social infrastructure underutilization, or a source of stress to a fully-employed areas resource base, creating temporary and long-lasting problems such as housing shortages, traffic congestion, lower quality of police and fire protection, and overcrowding in hospitals and classrooms. The potential severity of the impact is related on the one hand to type, magnitude, and timing of the new development and on the other hand to capacity of the local area to accomodate the change and the quality and timeliness of planning responses.

Impact on Employment

The discovery of oil and/or gas on the Georges Bank could create many employment opportunities in the North Atlantic. The potential employment impacts are far greater than those related to the number of new jobs directly generated by the new primary activity. A chain of secondary expansions will occur as a function of this initial activity and growth will be experienced in many sectors; this is often referred to as the "multiplier effect". Thus, the total impact on regional employment will involve three components of change. These are direct employment, indirect employment, and induced employment.

Direct Employment

Direct employment is defined as those jobs generated by establishments engaged in primary activities such as exploration, drilling, oil and gas well operation and maintenance, and the operation of natural gasoline or cycle plants, either directly or on a contract basis (SIC Code 13).

Direct employment estimates for the North Atlantic region (Table IV.C.13-1) were derived by combining the U.S. Geological Surveys conditional mean resource production and offshore construction schedule with several widely accepted OCS development studies (NERBC, 1976a, 1976b, Frederick R. Harris, Inc., 1977).

These jobs will be concentrated in the counties postulated to be directly involved in OCS activities. In the proposed Sale No. 52 mean scenario (see Appendix C) these include, in order of direct employment impact, Davisville, Washington County, RI (operations support base), Stapleton Piers, Richmond County, NY (operations support base) and Fall River, Bristol County, Mass. (gas facility).

Indirect Employment

Indirect employment is defined as those jobs generated in regional or local industries involved with machinery, supplies, and facilities necessary to the primary activities.

Indirect employment estimates were derived using employment multipliers suggested by county business patterns and controlled to earlier analyses of similar onshore impacts which utilized the multiregional, multi-industrial forecasting model developed by Curtis B. Harris, Jr., of the University of Maryland, as well as other studies performed for this region. Indirect jobs will basically be a function of the degree to which principal products and services are available in the region and will be generated in those areas containing proper infrastructure and located as close as possible to the primary area. In the case of the North Atlantic, few of the principal products required for OCS operations are available in large quantities, and many OCS operation products may be supplied from the Gulf Coast.

Induced Employment

Induced employment includes those jobs generated by the additional consumer spending which will result from the increased payrolls generated from the direct and indirect activities.

Induced employment estimates were generated using employment multipliers suggested by earlier studies performed in this area. The magnitude of these multipliers is related to the diversity of the area's economy.

Since these jobs are a function of the new income generated during direct and indirect activities, they will be concentrated, to a great extent, in the counties postulated for primary activities. They will also be scattered in the few industrial areas which may get involved in indirect activities.

Total Employment

Using these estimates of the three components of change, estimates were derived of total employment (Table IV.C.13-2) which could be generated in the study area by the proposed sale. These estimates, as any estimates of employment generated by new industrial activity, are not intended to be exact predictions but were developed to provide an understanding of the general extent of OCS impacts, to identify some potential onshore problems, and provide a general understanding of the factors that could determine socio-economic impacts.

According to this analysis, the proposed sale will generate a peak increase of 7,120 direct, indirect and induced jobs in 1996 in the New England Region. This represents less than one tenth of one percent of the study areas total civilian employment from all sources.

The majority of these employment increases will be concentrated in those counties experiencing the greatest direct activity. These are Washington County, RI, Richmond County, NY, and Bristol County, Mass. The employment increases estimated, if experienced roughly in proportion to direct activity anticipated, represent minor increases in the total civilian employment of Richmond County and Bristol County (less than or equal to one %), and a moderate increase for Washington County (slightly over 10%). Some additional employment gains will also be scattered in various industrial areas in the region. Such increases as might be expected should be negligible relative to current total civilian employment.

New Resident Employment

The total employment estimates make no distinction between those jobs filled by local hiring and those filled by relocating workers. This distinction is important because it is these relocating workers, called new resident employees, and not the local hires, who will put new demands on public and private services and thus generate the greatest infrastructure impacts.

There is no standard relationship between new resident employment, local hire, and total employment. The proportions of local hire and new resident employment will fluctuate with both the quality (skills) and quantity (supply) of local labor. Both quality and quantity will vary over time with other job opportunities and training. Therefore, local hiring can vary from miniscule to extensive. These two cases have been examined.

Case one assumes, whether due to a lack of labor supply and/or necessary skills, that no local hiring occurs and all the employment opportunities will accrue to new residents. In such a case the total employment estimates (Table IV.C.13-2) will also represent the new resident employment anticipated. This is considered a "maximum impact" case and is referred to as such through the rest of this section.

Case two assumes extensive local hiring. Estimates (Table IV.C.13-3) were made of new resident versus local hire using trends identified in several studies (Roy F. Weston, Inc. in association with Frederick R. Harris, Inc., 1978; Woodward-Clyde Consultants, 1975: Arthur D. Little, Inc., 1975). While these are rough estimates, they are thought to be representative of the hiring pattern that could occur in an area of New Englands diversity. According to this analysis peak new resident employment is 2,850 jobs in 1996. This is considered an "adjusted impact" case.

This same "new resident" vs. "local hire" allocation methodology has not been extended to the county level for a number of reasons. First, though the region itself may be expected to experience limited <u>inter</u>regional migration and new resident employment, primary counties might experience extensive <u>intra</u>regional migration (i.e. migration from nearby counties). This <u>intra</u>regional migration, which would be considered local hire on a regional basis, represents new population on a county basis. Also, it is much harder to make assumptions and to quantify the degree to which the local labor force of a county may get involved in new activity since the potential labor forces are much smaller and of less diverse talents than the regional labor force. Such an estimate would be very sensitive to small changes in quality and quantity and could be very variable over time. Therefore, though it is anticipated that some jobs may go to locals of the county, the "maximum case" number will be used to examine county level impacts.

It should be viewed as a maximum impact analysis, and interpreted with the understanding that in reality some percentage of this employment, which will vary with the supply and skills of the county level local labor force, will likely go to local residents.

<u>New Resident Population</u>

It is assumed that new resident population will be generated in direct proportion to the amount of new resident employment. New resident population is perhaps the best indicator of the potential impact on the

demand for public and private services and facilities. Both the total growth in population and the period of time over which the growth is expected to occur (rate of growth) are important in determining the potential impact on an area's or a community's economic and social well-being.

The estimated new resident population generated by the OCS activity related to the proposed sale is summarized on Table IV.C.13-4.

The first column represents the estimated population growth related to the "maximum case", in which it is assumed that none of the OCS-related employment is taken up by current local residents. As such this may be considered the maximum potential population increase. The second column represents the "adjusted case", which considers the likely possibility that a certain amount of the employment opportunities generated may be filled by local residents.

The estimated peak year maximum new population generated in the North Atlantic Region is estimated at 16,370 persons in 1996, which is less than .01% of the current total population. Assuming local labor force participation in OCS generated employment, peak population generated by population proposed Sale No. 52 would be 6,560 persons in 1996, also less than .01% of the current population.

The majority of the regional population increases described above will be concentrated in the three counties involved in primary employment activity - Washington County, RI, Richmond County, NY, and Bristol County, Mass. Increases of the magnitude implied, when applied on the county level, could imply significant increases in new resident population relative to existing population. This is particularly true of Washington County, RI, which has both the lowest baseline population of the three primary counties and the greatest anticipated level of activity. If, for example, Washington County experiences population increases in direct proportion to its share of direct employment, this would represent a population increase of 12%.

Impact on Infrastructure

Increases in local and regional population will cause corresponding increases in demand for public and private community services and facilities such as housing, education, and police and fire protection. These increased demands have the potential to either stimulate a community into full utilization of infrastructure, or stress a fully utilized community's services and facilities.

Analysis of the estimated total new resident population growth figures, and their average annual rate of growth relative to existing population levels, indicates that, even in the maximum case, it would be highly unlikely that the study area as a whole would be subjected to an amount or rate of population growth that would strain its ability to adequately provide community services and facilities.

On a county level, the implications could be more significant. Population increases of the magnitude estimated imply increased demands and potential deficiencies in social and physical infrastructure. This is especially true of Washington County, RI, which may experience a population increase of approximately 12%. With proper and timely planning these should be no more than short term inconveniences. Areas such as Bristol County, Mass. (gas facility), which has experienced an economic decline, and Washington County, RI (operations support base) which has experienced net out-migration, may be better equipped to handle new demands than areas working at full capacity and may not require a great deal of new physical and social infrastructure.

Conclusion: It is estimated that the proposed action could increase the number of persons employed in the New England Region by 7,120 persons. This represents less than one tenth of one percent of the existing total employment from all sources in the study area. This figure represents the maximum number of new resident employees anticipated to relocate as a result of the proposed sale. This figure represent no local hiring. Under the assumption that some percent of the potential employment opportunities will go to current residents of the region new resident employees were estimated at 2,850.

The maximum new resident population associated with these new resident employees is 16,370 persons, which is less than one tenth of one percent of the current study area population. Under the local hire assumption, population increases are estimated to be 6,560 persons, also less than one tenth of one percent of the current study area population.

The new resident population increases generated, while insignificant on a regional level, may not be uniformly insignificant throughout the region. The three counties involved in primary activities, Washington County, RI (operations support base), Richmond County, NY (operations support base), and Bristol County, Mass (gas facility) may experience moderate increases in demands for public and private facilities. These increased demands could be most significant in Washington County, where the peak year population increase estimated is 12% of the current population. The gradual nature of OCS buildup should reduce the possibility of severe impacts and if new facilities are necessary, proper and timely local planning should prevent all but short term incoveniences. Also, a certain degree of local hiring on the county level may mitigate such potential impacts.

Cumulative Impacts

The cumulative effect of this proposed sale together with Sale No. 42 (Georges Bank) and Sales No. 40, 49, and proposed Sale No. 59 (Baltimore Canyon) would represent a larger socio-economic impact on the North Atlantic Region than the effect of this proposed sale alone.

In a strictly additive sense, peak employment in the North Atlantic attributable to cumulative OCS activity in the Mid and North Atlantic would be 27,690 jobs in 1996. This figure, which includes direct, indirect, and induced employment, represents an increase to the regional civilian labor force of only one quarter of one percent. About 7,120 of these jobs would be the result of this proposed sale, 2,870 would be the result of OCS Sales 40 and 49, 570 would be the result of sale 42, and 17,430 the result of Sale 59.

The cumulative employment impacts are more significant on a county basis. Washington County, for instance, which has been hypothesized as support base for both North and Mid Atlantic Operations, will share in over 50% of the 27,690 jobs projected in the cumulative analysis. Such an addition represents a significant increase in the current civilian labor force.

Cumulative population increases follow a similar pattern. While insignificant on a regional basis - roughly less than one third of one percent - much of this increase will be concentrated in Washington County, RI and significant population increases may be experienced. Such increases in population will cause corresponding increases in demands for public and private services and facilities and in a county such as Washington County, RI, short term stress may be felt.

Conclusion: Cumulative employment resulting from Sales 40, 49,42, and proposed Sales No. 59 and 52 could reach a peak of 27,690 jobs in 1996. An increase of this magnitude is insignificant on a regional level, representing an increase of only one quarter of one percent over the current level of civilian employment. Cumulative population increases follow a similar pattern and will also be insignificant on a regional level.

Cumulative employment and population will be more significant on a county level. Washington County, RI, with a projected share of over 50% of the 27,690 jobs generated, will experience a significant increase in the current civilian labor force. Related cumulative county population increases could cause short term shortages in public and private services and facilities in the Washington County, RI area.

Alternative 2: Delay the Sale

A delay in holding this sale until information on the impacts of Sale No. 42 are available would not eliminate the employment and population impacts under Alternative 1, but would give the North Atlantic states additional time and experience with which they may better plan for any associated socio-economic impacts and thus mitigate possible infrastructure stress.

Conclusion: Delaying the sale would postpone all economic impacts, both positive and negative, and possibly allow time to plan for community adjustments to potential increases in population and economic activity. These impacts include a maximum peak increase of 7,120 jobs and 16,370 people.

Alternative 3: Cancel the Sale

Cancelling the sale would eliminate all direct, indirect, and induced economic activity assumed to stem from the proposed sales, but not all economic activities in the region, since Sales 40, 49, and 42 have already occurred, and the potential effects from proposed sale No. 59 will still exist. These sales (40, 49, 59, 42) alone could cause a peak regional increase of 20,800 jobs in 1999.

Conclusion: Cancelling the sale would mean that the North Atlantic region would forego all economic activity, both positive and negative, assumed to occur under Alternative 1. This represents the loss of a maximum of the 7,120 OCS related jobs projected in 1996, as well as a lesser number of jobs in other years, and the associated peak population increase of 16,370 persons.

Alternative 4: Modify the Proposal by Deleting Tracts In Water Depths Greater Than 2000 Meters

Since this alternative would remove only about 9 percent of the proposed sale area, the socio-economic impacts generated by OCS development and infrastructure requirements will be nearly identical to those necessary in Alternative 1. The same number of OCS facilities such as operations support bases, and the same gas facility could be required, though necessary capacities would be less. Therefore, only minor reductions in the number of jobs (250 jobs) and population (550 persons) could be expected.

Conclusion: Socio-economic impacts could be reduced very slightly over those expected under Alternative 1.

Alternative 5: Modify the Proposal By Deleting Tracts to Protect Fisheries and Other Biological Resources

Although this alternative involves the deletion of approximately 37 percent of the tracts under consideration, it is assumed that approximately 80 percent of the estimated potential recoverable resources still remain in the area. Therefore, the same number of OCS facilities such as the operations support bases and the gas facility could be required and, though necessary capacities would be reduced, this would not be proportionate to the number of tracts deleted. A reduction of approximately 1,250 jobs and 2,900 persons could be expected.

Conclusion: A minor to moderate reduction in socio-economic impacts would be experienced over those expected in Alternative 1.

Alternative 6: Canyon Deletion Alternative

Since this alternative would remove only about 6 percent of the proposed Sale area, the soci-economic impact generated by OCS development and infrastructure requirements will be nearly identical to those in Alternative 1. The same

number of OCS facilities could be required, though necessary capacities would be less. Only minor reductions in the number of jobs and population could be expected.

Conclusion: Socio-economic impacts would be reduced insignificantly over those expected under Alternative 1.

Alternative 7: Alternative Considering Marine Sanctuaries

The Georges Bank

This alternative imposes certain regulations to protect the fishery resources of the Georges Banks. Compliance with such regulations might involve the generation of new jobs and differing transportation arrangements not anticipated in Alternative 1. These increases and changes, though, should be quite small relative to the level of activity anticipated.

Conclusion: Socio-economic impacts should be nearly identical to those anticipated in Alternative 1.

Alternative 8: Geohazards Alternatives

Since this alternative represents the removal of 18 percent of the study area, some reduction of soci-economic impacts could be expected to result from the deletion of these tracts. It is likely that the same number of OCS facilities could be required, but necessary capacities would be less.

Conclusion: A minor to moderate reduction in socio-economic impacts would be experienced over those expected in Alternative 1.

Table IV C.13-2

Total Employment

1985	190
1986	360
1987	220
1988	130
1989	-
1990	-
1991	-
1992	1450
1993	1160
1994	5530
1995	5930
1996	7120
1997	5190
1998	4820
1999	2720
2000	2530
2001	2630
2002	2710
2003	2530
2004	2450
2005	2450
2006	2480
2007	2470

[1]Excluding transients

SOURCE: BLM Estimates, 1981

Table IV.C.13-1

Direct Employment[1] Assumed to Result from the Proposed Sale (Main Scenario)[2]

Year	At onshore Support Bases[3]	At other Onshore Facilities[4]	Employment Offshore[5]	Total
1985	38		43	81
1986	74		78	152
1987	38		54	92
1988	24		27	51
1989	-		-	-
1990	-		-	-
1991	-		-	-
1992	199		223	422
1993	170		103	273
1994	437		993	1430
1995	495	45	1509	2049
1996	677	63	1759	2499
1997	428	71	1267	1766
1998	324	71	1011	1406
1999	202	64	698	964
2000	182	57	634	873
2001	182	51	654	887
2002	186	45	658	889
2003	191	41	657	889
2004	191	36	667	894
2005	192	32	676	900
2006	192	28	705	925
2007	192	26	704	922

[1]Excluding Transients (i.e. workers living aboard a rig and commuting home out of the region between shifts).

[2]See Appendix C for an explanation of the various scenarios.

[3]Includes warehouse, administrative, boat, and helicopter workers. Allocated approximately: 80%-Washington County, 20% - Richmond County.

[4]Employment for operating gas facility; excludes construction workers.

[5]Allocated approximately: 80%-Washington County, 20% - Richmond County.

SOURCE: BLM, Estimates, 1981

Table IV.C.13-3

Case 2: Estimated New Resident and Local Resident Employment

	Local	New Resident
1985	70	120
1988	40	90
1991	-	-
1994	2760	2770
1996[1]	4270	2850
1997	3110	2080
2000	1650	880
2003	1650	880
2006	1610	870

[1] Peak Year

Note: Computations are rounded to the nearest ten.

SOURCE: BLM Estimates, 1981

Table IV.C.13-4

Estimated New Resident Population

	Maximum Case	Adjusted Impact Case
1985	430	280
1988	300	210
1991	-	-
1994	12,710	6,370
1996	16,370	6,560
1997	11,950	4,780
2000	5,830	2,020
2003	5,820	2,020
2006	5,700	2,000

[1]Peak year

Note: Assumes new resident population multiplier of 2.3 per new resident employee. Computations are rounded to the nearest ten.

SOURCE: BLM Estimates, 1981.

14. Unavoidable Adverse Environmental Effects

Normal offshore operations associated with exploration and development would have unavoidable effects of varying degrees on the quality of the surrounding water. The discharge of drilling muds and cuttings would cause temporary increases in suspended solids and accompanying trace metals in the immediate vicinity of drilling rigs. Discharged formation waters would cause localized, minor elevations in inorganic salts, trace metals, and hydrocarbon levels around platforms. In addition, oxygen levels near the point of formation waters discharge could be slightly reduced. Oil spills and chronic discharges of oil would temporarily increase hydrocarbon levels in the water column. Oil would disperse, undergo weathering, and settle to the bottom to become incorproated into the sediments.

Discharges of treated sewage from rigs and platforms would increase levels of suspended solids (organic matter), BOD, nutrients, and chlorine in the immediate vicinity of the discharge. Finally, temporary water column turbidity would be caused by pipeline installation due to resuspension of sediments.

It has been projected that approximately 10 spills greater than 1000 barrels could occur as a result of the proposed sale. Spilled oil that is not recovered would release hydrocarbons and trace metals into the environment.

The quality of the surface, near surface, and to a lesser extent, deeper waters would therefore be lowered temporarily. If oil is entrapped in bottom or shoreline sediments, this degradation would continue over weeks or months while the oil was slowly reintroduced into the system.

Minor decreases in planktonic and benthic organisms will occur in localized areas of high turbidities generated by drilling fluids disposal, and bottom sediments will be temporarily disrupted by pipe laying and burial operations. The possibility exists that toxic matierals used in mud mixtures may adversely affect some marine organisms in localized areas when drilling fluids and cuttings are discharged.

Commercially important species will be affected by mortality to fish eggs and larvae and smothering of shellfish. Commercial fishermen will be affected by spatial exclusion of fishing activities and possible damage to gear. Spilled oil will cause some mortality in finfish and shellfish. It has been projected that the greatest percentage of area that could be lost is 2.0% in the ground fish otter trawl (flounder) and the greatest percentage of catch-loss that could be lost is 0.41% in the lobster otter trawl fishery.

Due to the relatively high number of oilspills (10) estimated to occur during the production life of the proposed Sale, several endangered species may be adversely affected, particularly during migratory periods. These species

include the peregrine falcon; the loggerhead, leatherback, and Atlantic ridley turtles; and potentially all species of endangered whales. Marine birds would be expected to suffer significant losses if one or more large oil spills occurs in the region. Sensitive coastal areas (i.e. wetlands, estuaries, and sandy beach/dune areas) may be impacted by oil spills particularly along the south shore of Long Island, Martha's Vineyard, and Nantucket Island. Pipeline landfalls in Rhode Island may temporarily disturb sandy beache areas.

Unavoidable land use impacts, such as those resulting from pipelaying and related land disturbances will be localized and temporary in nature. The two projected pipelines could need from approximately 250 to 350 acres of land for their rights-of-way. These pipelines will be buried onshore. Approximately 100 acres of land would be needed for the gas processing plant.

Industrial development and population growth due to the proposed sale will cause substantial increases in the emissions of air pollutants. The pattern and type of economic activity that is forecast could cause minor short-term stress on the physical and social infrastructure of some communities, especially those involved in primary OCS activities.

15. Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

For purposes of this section, short-term is defined as the projected economic life of the project, and long-term is defined as the period that follows the economic life of the project. The principal short term use of the area will be for the production of oil and gas, non-renewable resources.

The proposed sale may result in employment and population increases, and in short-term adverse impacts to some communities. A strain on existing public and private services and infrastructure could be expected if new, OCS-related facilities are located in areas of low population with little current industrial base. However, in the long-term, a return to equilibrium can be expected as population gains and induced industrial development are absorbed in the expanded communities. Incremental long-term gains in levels of employment and population can be expected to accrue.

Many of the construction related impacts would be short-term in nature and consequently have a minimal amount of impact on the environment as a whole. For example, a particular segment of land would be disrupted by pipeline construction for only three to four weeks. Pipelines will be buried and within a short time the land can be restored to its previous condition.

Short-term impacts could occur to the recreation resources and tourism economies of the area from an oil spill if a spill contacted a beach during the peak summer season. All shoreline areas adjacent to the proposed sale have high recreational use.

Short-term use of the OCS for mineral extraction will preclude fishing in the immediate vicinity of oil and gas operations. Although fishing takes place close and within the proposed lease area, only a small portion of the total fishing area would be removed.

Short-term adverse effects to marine biological communities would result from normal operations and oil spills. Short-term losses could include reduction in biological productivity, changes in marine habitats, reduction of populations of plantkton, benthos, fish, birds, mammals and turtles, and modifications of the food web.

After the project, oil spills due to the proposed sale and their impacts will not occur, and the marine environment is generally expected to remain or return to preleasing productivity in OCS areas where oil and gas have been produced for many years. It has been recognized that continuous low level pollution from toxic chemicals, including oil, may adversely affect long-term productivity, but the extent cannot be projected until reliable data become available.

Of the species in the region protected by the Endangered Species Act, marine species, especially turtles, may suffer population reduction. Coastally-oriented endangered species will probably not be affected significantly. Important feeding and breeding areas for endangered whales should not be affected by OCS-related activities, but whales migrating to these areas must pass through the proposed sale area. This could lead to changes in the migratory behavior of these whales. However, there is insufficient information to accurately predict any long-term effects.

In summary, short-term, localized impacts, both environmental and socio-economic, would result from this proposed sale. No long-term productivity or environmental gains with regard to natural resources are expected as a result of this proposed sale. Benefits are expected to be principally those associated with increased supplies of domestic oil and gas and lessened dependence on foreign sources.

16. Irreversible and Irretrievable Commitments of Resources

Leasing of the proposed tracts and subsequent development and extraction could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The U.S. Geological Survey estimates net recoverable resources to range from a low of .017 to a high of 6.35 billion barrels of oil and from .196 to 13.49 trillion cubic feet of natural gas. These estimates assume that hydrocarbons exist in commercially recoverable quantities, and there is a 40% chance that they do.

An irreversible or irretrievable commitment of biological resources and their habitats could occur in the area of a massive oil spill, or near areas that are subjected to chronic low levels of pollution. It is anticipated that an affected area will recover from a spill and that the natural flora and fauna would eventually reoccupy spill areas. Exceptions would be that irreversible or irretrievable losses of an endangered species may result if populations of such a species are affected by an oil spill, either directly or through food contamination, or by any other disruption or disturbance such as habitat loss that may result from the proposed sale.

Deaths and permanent disabilities from OCS offshore operations are an irretrievable loss of human resources. During the period between 1970 and 1978, there were 138 fatalities and 212 injuries from such activities on the U.S. Gulf of Mexico OCS. However, most accidents have been minor in nature. Human casualties and injuries have been minimized through measures already in place which are continually updated to improve the safety of OCS operations.

The proposed sale would require land for rights-of-way for two natural gas pipelines, a gas processing plant, and operations support bases. Additional land for facilities stimulated in part by this proposed sale could also be required. Where new land uses result in the disruption or destruction of natural features or processes, such that the return to the previous land use is not possible, an irreversible commitment of resources would occur. Because of the land use controls available to states and local governments, and the fact that wetlands will generally be avoided whenever possible, changes in land use in the region should not be significant.

A decision to proceed with proposed Sale No. 52 would result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas or of other types would be foregone. Steel products, specialized manpower, and capital constitute required resources which may be scarce; and use of these resources to develop the North Atlantic sale area could mean that other opportunities for their use might have to be foregone. While these resources may be reclaimed over time, their use as a result of this proposed sale, would constitute an irreversible and irretrievable commitment of resources at a given point in time. To the extent that unemployed resources are used, the employment of resources would not constitute a cost to society in the form of foregone opportunities.

Damage to archeological artifacts, sites, or historic shipwrecks would constitute an irretrievable loss of nonrenewable resources that could reflect early human occupation of the area. However, considering the paucity of evidence of human occupation of the North Atlantic OCS and the distance of the tracts from shore the likelihood that activities resulting from the proposed sale would encounter such resources is considered remote.

D. Effects of Changes to the Basic Development Assumptions

It is possible that development could vary if other than the mean level of resources was discovered. The following are development assumptions associated with the low and high resource estimates, as well as summaries of their environmental consequences.

Low Resource Estimate

In the low level resource estimate production of .017 billion barrels of oil and .196 trillion cubic feet of gas would be expected. Peak production would be 4,330 barrels of oil per day and .067 billion cubic feet of gas per day, and would occur in 1997.

There will be considerably less offshore activity such as well drilling and platform installation, no gas pipeline or gas plant constructed, no expansion of existing refining facilities, and no need for the operations support base postulated in Richmond County, N.Y. In most cases, environmental impacts will be negligible under the Low-Resource-Estimate development assumptions.

High Resource Estimate Resources

In the high level resource estimate production of 6.35 billion barrels of oil and 13.49 trillion feet of gas would be expected. Peak production would be 1,563,000 barrels of oil per day and 2.89 billion cubic feet of gas, and would occur in 1999.

Offshore Activity

The number of wells per year, year of installation of platforms and the production schedules are given in Table IV.D-1. A total of 30 platforms and 97 subsea complexes would be required to produce the resources. Twenty-seven exploratory wells, 24 delineation wells, and 1,183 development wells would be drilled.

Transportation Modes

Pipelines for the gas and tankering of the oil are the assumed modes of transportation. Two 42 inch gas pipelines totalling approximately 335 miles offshore would be needed. Figure IV.D-1 shows the projected routes as well as the location of facilities for this scenario.

Pipelines

One pipeline, the southernmost pipeline, could follow the same route, offshore and onshore, and use the same landfall as assumed in the mean case. The other would follow a more northern route to shore, making its landfall in the Barnstable area of the southern shore of Cape Cod. Onshore it could traverse Barnstable, Sandwich, Barne, Plymouth, and Wareham, to its termination point in the Middleborough, Carver area.

Tankers

It is assumed that crude oil produced could be transported by tanker, via existing tanker routes, to refineries along the Raritan and Delaware Bays, as well as the Gulf of Mexico area during peak years.

Gas Facilities

Gas from the southernmost pipeline may be dehydrated, processed, and treated in the Fall River area of Bristol County, Massachusetts, and that from the northernmost pipeline in the Middleborough, Carver area. Each of the two gas facilities would have a capacity of approximately 1.45 billion cubic feet per day.

Operation Support Bases

In addition to those projected in the mean case, a site in Rockingham Co., NH is assumed to be used.

Summary of Environmental Consequences: High Case

Assuming the high level of resources are recovered and transporte to shore by pipelines and tankers, the deegree of impact could increase significantly over that described under Alternative 1.

The effects of increased air emissions offshore would be temporary and localized, as pollutants would rapidly diffuse in the offshore air mass. Impacts affecting the offshore environment from platform discharges could be approximately one third more than is expected under the mean case. The expected number of oil spills is considerable higher under the high case: 30 as opposed to 10 under the mean case.

Onshore air quality impacts would be extended due to pollutants generated by an additional gas processing plant an operations support base, and possible refinery expansion. The potential impacts would not differ in kind from those described for the mean resource case, but additional locations would be affected.

Impacts on water quality would be the same as those described for the mean estimate. These impacts, however, would increase in magnitude as volumes of drilling muds and cuttings, formation waters, oil spills and chronic discharges of oil, and domestic and sanitary wastes would be significantly greater under this case.

The total volume of drilling muds and cuttings discharges over the life of the field would be 2.5 times greater than that for the mean case (see Table IV.C.2-1) However, impacts on water quality would still not be significant primarily because over 90 percent of the discharged material rapidly settles to the bottom upon discharge and the relatively small volume of materials in the upper plume disperses to background levels in the large volume of receiving water within a short distance and period of time.

There would also be significant increases in impacts from major oil spills. OSTAM predicts 30 spills over 1,000 barrels in size could occur over the life of the field under the high case - and from chronic discharges of oil, including that from deck drainage and formation waters.

Sensitive coastal habitats would face a higher probability of being impacted by one or more oil spills over the production life of the proposed lease area under the high case find (Appendix D, Tables 11 and 12). In general, the same sensitive coastal habitats that were particularly vulnerable to sale related oil spills under the mean case find are also vulnerable under the high case find. However, during the peak production years, crude oil recovered from the sale area may be transported via tankers to refineries in the Gulf of Mexico. This could increase the risk of an OCS-related oil spill occurring and impacting sensitive coastal areas in both the South Atlantic and Gulf of Mexico regions.

Impacts from onshore facilities and service bases should be minimal as the additional facilities and base are expected to be located in areas that would not be considered sensitive to development. A large diameter gas pipeline transiting Nantucket Sound, which is included in the Cape and Islands Ocean Sanctuary, with a landfall on a sandy beach area will disturb these areas during the period of pipeline construction. However, no significant long term adverse impacted are expected.

Adverse impacts to birds could be greatly magnified due to the large increase in the estimated number of oil spills greater than 1,000 barrels (30 in the high case vs. 10 in the mean case) and to an approximate four fold (3.7 x) increase in the amount of crude oil that can be chronically discharged in formation waters from production platforms. Long-term population declines and high mortality rates should be expected, particularly for pelagic species, under this case.

Endangered species would face a greater risk of impact from the high case find due to the large number of estimated spills and to the increased probability of one or more oil spills contacting areas of importance to these species (Appendix D, Tables 11 and 12). The high number of expected spills could have an especially harmful effect on endangered turtles and whales. In addition to the areas that were particularly vulnerable under the mean case find, endangered species and their habitats in the South Atlantic and Gulf of Mexico regions could be impacted by an oil spill from Sale No. 52 tankers transiting these regions during peak production years. Sea turtles and whales would be exposed to an increased risk of ship collisions as approximately 130 vessels (an approximate 50% increase over the mean case) would be servicing the lease area by 1996. The cumulative effect of the high case find could result in high morality rates and population declines, particularly for marine species.

The probability that an oil spill greater than 1,000 barrels will occur in the proposed sale area over a 30-year period and contact Martha's Vineyard within 30 days is 26% (Appendix D, Table 12), in contrast to 20% for the mean case. For Nantucket, the comparable probability is 34% in contrast to 25% for the mean case. Thus, recovery of the high resource estimate poses a greater degree of risk to coastal recreation areas from oil spills originating in the propose sale area.

In this case, there is an assumed pipeline landfall near Hyannis in the town of Barnstable on Cape Cod. All of Cape Cod is important for recreation, but since this would be a natural gas pipeline, the potential for adverse impact is essentially limited to the construction phase. Therefore, if the pipeline is constructed during the off-peak season for beach use and the landfall site is restored, there should be no significant impact to recreation caused by siting this landfall on Cape Cod. In general, under the High Case, coastal recreation resources, particularly those on Nantucket and Martha's Vineyard, face a higher probability of being contacted by oil spills.

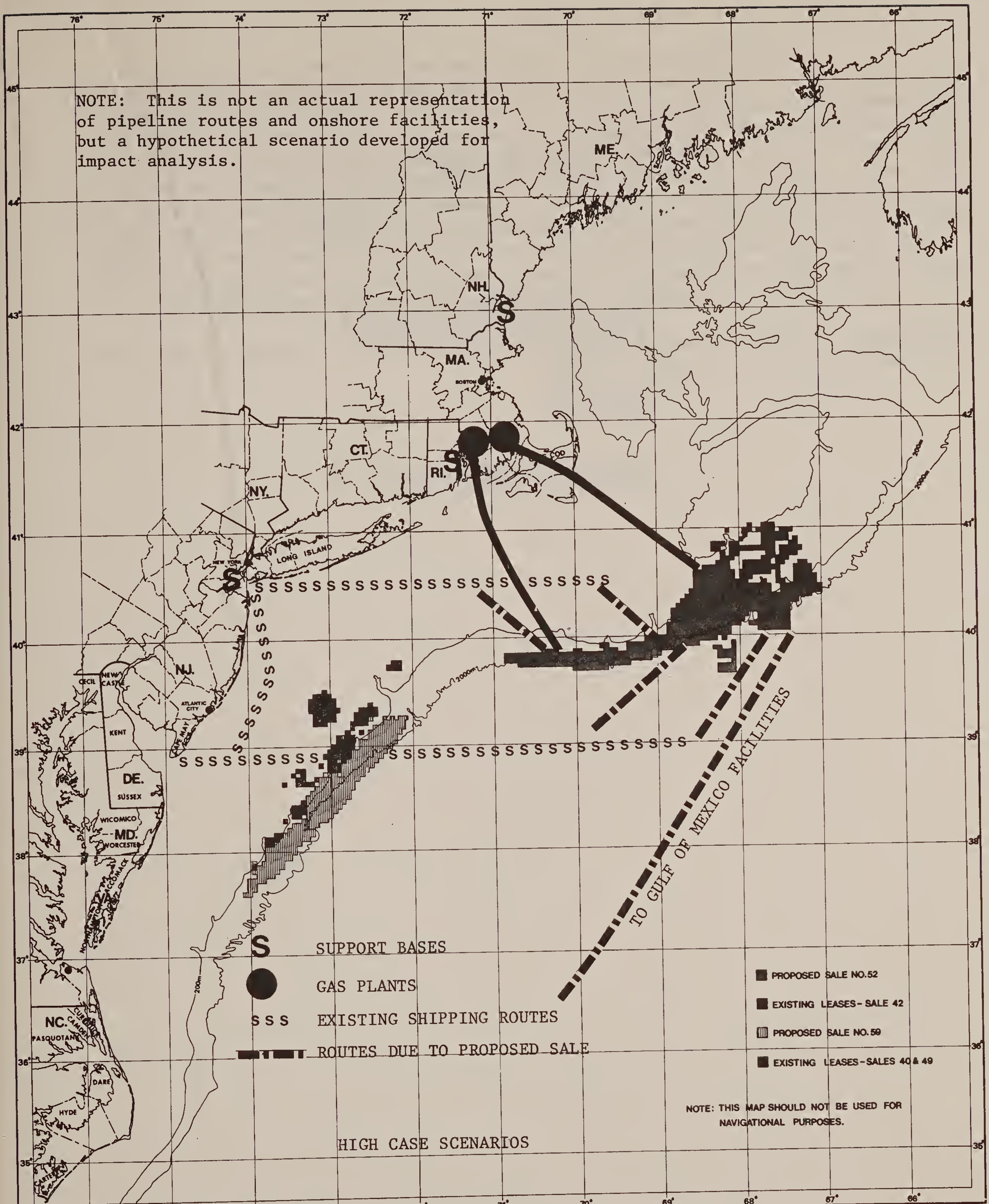
Since the resource estimates associated with this scenario are considerably higher than those of the mean case, socio-economic impacts can be expected to be correspondingly greater. Regional employment increases related to the degree of activity associated with the high case is forecast to reach a peak of 12,700 jobs in 1997 (versus 7,120 jobs in the mean case). Associated peak regional population would be nearly 30,000 persons in 1997 (versus 16,370 persons in the mean case). Increase of these magnitudes are very minor on a regional basis.

The employment and population increases forecast will be more significant on the county level. The impacts described above will be concentrated in Washington County, RI (operations support base), Richmond County, NY (operations support base), and Bristol County, Mass. (gas facility), which were the primary counties postulated in the mean case, as well as Rockingham County, NH (operations support base) and Plymouth County, Mass. (gas facility).

Impacts of the magnitude expected should put no more than short-term stress on the public and private services and facilities of all the counties postulated with the exception of Washington County, RI. According to this analysis, Washington County may experience a population increase of between 15 to 20 percent over their current population. Without proper planning such an increase can cause significant stress. Institutional controls may keep such growth in check.

Table IV.D-1. Yearly production rates which could result from the conditional high resources estimates for proposed Sale No. 52.

Year	Expl. Wells	Delineation Wells	Plats	Subsea Complxs.	Total Wells Drilled	Production Oil (MB/YR)	Schedule Gas (MMCF/YR)
1983							
1984							
1985	13						
1986	10	12					
1987	4	9					
1988		3					
1989							
1990							
1991							
1992			10				
1993			10				
1994			7	7	91		
1995			3	15	181	173374	323155
1996				20	236	304359	567896
1997				20	251	429560	806123
1998				14	175	494997	917680
1999				10	116	514297	951712
2000				5	66	497503	930835
2001				3	40	465637	883249
2002				2	21	425293	818485
2003				1	6	379370	745427
2004						334282	675431
2005						294561	612173
2006						259568	554990
2007						228738	503286
2008						201576	456521
2009						177645	414213
2010						156560	375926
2011						137981	341268
2012						121612	309887
2013						107188	281465
2014						94477	255716
2015						83277	232383
2016						73407	211233
2017						64709	192057
2018						57044	174665
2019						50288	158887
2020						44335	144570
2021						39087	131576
2022						34462	119777
2023						30386	109063
2024						26792	99331
2025						19658	73307
2026						13873	51967
2027						8549	31606
2028						4908	18070
2029						1266	9410
2030						505	4557
2031						113	1741



NOTE: This is not an actual representation of pipeline routes and onshore facilities, but a hypothetical scenario developed for impact analysis.
ME.
NH.
MA.
BOSTON
CT.
RI.
NY.
LONG ISLAND
NEW YORK
NJ.
ATLANTIC CITY
CAPE MAY
KENT
DE.
SUSSEX
MD.
WICOMICO
WORCESTER
VA.
NC.
PASQUOTANK
DARE
HYDE
S SUPPORT BASES
GAS PLANTS
S S S EXISTING SHIPPING ROUTES
ROUTES DUE TO PROPOSED SALE
TO GULF OF MEXICO FACILITIES
PROPOSED SALE NO.52
EXISTING LEASES- SALE 42
PROPOSED SALE NO.59
EXISTING LEASES-SALES 40 & 49
NOTE: THIS MAP SHOULD NOT BE USED FOR NAVIGATIONAL PURPOSES.
HIGH CASE SCENARIOS

Figure IV.D.1

1. Effects on Nantucket Sound

Pipeline construction would have no effect on air quality in the Sound. If trenching or burial of a pipeline in Nantucket Sound occurred, there would be a temporary increase in turbidity. Impacts to phytoplankton and zooplankton would be negligible. Disruption of the benthic population would occur along the pipeline route, but recolonization would occur in five years or more. A possible conflict could develop between commercial fishing and placement of a pipeline. Proposed Stipulation No. 3 states that when feasible and environmentally preferable, all pipelines to be buried to a depth suitable for adequate protection from fisheries trawling gear, and other factors as determined on a case by case basis. Therefore, conflicts between pipelines and commercial fishing activities are not expected.

Conclusion: Possible impacts to Nantucket Sound from a pipeline under the High case would be of a minor nature.

Section 5

Consultation And Coordination

V. Consultation and Coordination

A. Development of the Proposal and the DEIS

During the development of the proposal and the DEIS, Federal State, and local agencies, industry, environmental, and fisheries groups, and the public were consulted in order to identify significant issues and potential impacts, to obtain descriptive information, and to identify reasonable alternatives to the proposal and effective mitigating measures. Coordination with other governmental agencies regarding proposed Sale No. 52 began in 1979 when BLM requested resource reports from all Federal agencies with expertise pertinent to the proposal and the proposed sale area.

On December 31, 1979, a Call for Nominations and Comments was issued, requesting expressions of industry interest in tracts within the call area and requesting comments on environmental issues related to oil and gas leasing in the area. Nominations were received from 10 companies and 40 comments of concern were received from Federal, State, and local government agencies, environmental and fisheries groups, and private citizens.

In April, 1980, the IPP's North Atlantic Technical Working Group was briefed regarding tract nominations and environmental issues, and recommendations were received from that group.

Following evaluation of the tract nominations and environmental information received in the process described above, BLM and USGS submitted a joint recommendation for tract selection to the Secretary of Interior. On June 30, 1980, the Department announced the selection of 540 tracts for further environmental study in the DEIS.

Following tract selection, scoping meetings were held with Federal, State, and local agencies, and the public in order to identify more clearly and specifically, issues and alternatives to be studied in the DEIS. A description of the scoping process and its results can be found in Appendix B.

Departmental Manual Part 655 DM 1 details procedures for inter-bureau coordination regarding OCS oil and gas leasing. Departmental agencies with interest and expertise in the OCS were consulted in accordance with these procedures during the development of the lease stipulations for this proposal.

Pursuant to Section 7 of the Endangered Species Act, formal consultation must take place between BLM, the Fish and Wildlife Service, and the National Marine Fisheries Service. This process was initiated by a formal consultation held on April 22, 1981. FWS and NMFS are required to provide BLM with a formal biological opinion within 90 days of the date on which consultation was initiated.

B. Review of the DEIS

This DEIS will be available for review for a period of 60 days by Federal, State, and local agencies and the public, and public hearings will be held on the proposal in November, 1981. All comments and information received will be considered during preparation of the FEIS.

The DEIS has been distributed to those federal agencies with interest or expertise pertinent to OCS oil and gas leasing, to State and local governments in the affected States, to organizations and individuals having an interest in the proposal, and to members of the public on request from BLM's New York OCS Office or Washington Office.

Federal agencies and States from which comments have been requested include the following:

U.S. Department of Commerce
- Office of Coastal Zone Management
- National Oceanographic and Atmospheric Administration
- National Marine Fisheries Service
- Maritime Administration

U.S. Department of Defense
- Army Corps of Engineers
- Air Force
- Naval Fleet Area Control and Surveillance Facility, Virginia Capes

U.S. Department of Energy
- Federal Energy Regulatory Commission
- Office of Leasing Policy Development

U.S. Department of State

U.S. Department of the Interior
- Bureau of Mines
- Fish and Wildlife Service
- Geological Survey
- National Park Service

U.S. Department of Transportation
- Coast Guard

U.S. Environmental Protection Agency

National Aeronautics and Space Administration

U.S. Nuclear Regulatory Commission

- Maine
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut
- New York
- New Jersey

Section 6

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Section 7

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Section 8

Appendices

APPENDIX A

TRACT LIST

Tract List

Tract	Block	Average Water Depths Meters	Feet	Approximate Distance from Shore Statute Miles
NK 19-9				
52-1	930	61	200	105
52-2	932	60	197	107
52-3	973	60	197	107
52-4	976	65	213	127
52-5	978	70	230	132
52-6	979	70	230	135
52-7	980	75	246	138
NK 19-11				
52-8	124	52	171	86
52-9	127	55	180	102
52-10	128	55	180	105
52-11	171	55	180	102
52-12	213	55	180	98
52-13	215	69	226	90
52-14	216	70	230	92
52-15	257	68	223	99
52-16	300	70	230	97
52-17	301	75	246	100
52-18	302	80	262	103
52-19	341	70	230	91
52-20	342	75	246	93
52-21	343	75	246	98
52-22	344	80	262	92
52-23	345	85	279	101
52-24	346	85	279	104
52-25	383	70	230	86
52-26	384	75	246	89
52-27	385	75	246	92
52-28	386	80	262	94
52-29	387	85	279	97
52-30	388	90	295	100
52-31	389	90	295	102
52-32	390	90	295	105
52-33	391	90	295	108
52-34	427	75	246	88
52-35	428	80	262	91
52-36	429	85	279	93
52-37	430	90	295	95
52-38	431	90	295	98
52-39	432	95	313	101
52-40	433	95	313	104
52-41	434	95	313	106
52-42	435	95	313	109
52-43	471	81	266	90
52-44	472	85	279	92
52-45	473	90	295	94

Tract	Block	Meters	Feet	Statute Miles
NK 19-11 (cont'd)				
52-46	474	95	313	97
52-47	475	100	330	100
52-48	476	105	345	103
52-49	477	135	445	105
52-50	478	120	396	108
52-51	479	110	363	111
52-52	480	110	363	113
52-53	515	90	297	91
52-54	516	95	313	100
52-55	517	95	313	96
52-56	518	100	330	98
52-57	519	105	345	101
52-58	520	110	363	104
52-59	521	285	940	106
52-60	522	310	1023	109
52-61	523	130	429	112
52-62	524	130	429	114
52-63	558	90	297	90
52-64	559	90	297	93
52-65	560	95	313	95
52-66	561	100	330	98
52-67	562	110	363	100
52-68	563	115	379	103
52-69	564	120	396	105
52-70	565	200	660	108
52-71	566	320	1056	110
52-72	567	140	462	113
52-73	568	140	462	116
52-74	601	90	297	90
52-75	602	95	313	92
52-76	603	95	313	95
52-77	604	105	345	97
52-78	605	105	345	100
52-79	606	115	379	102
52-80	607	125	412	104
52-81	608	135	445	107
52-82	609	415	1369	110
52-83	610	500	1650	112
52-84	611	145	478	115
52-85	612	140	462	117
52-86	644	90	297	90
52-87	645	95	313	92
52-88	646	100	330	94
52-89	647	100	330	97
52-90	648	115	379	99
52-91	649	120	396	101
52-92	650	125	412	104

Tract	Block	Meters	Feet	Statute Miles
NK 19-11 (cont'd)				
52-93	651	135	445	106
52-94	652	145	478	109
52-95	653	420	1386	112
52-96	654	630	2079	114
52-97	655	220	726	116
52-98	656	155	511	119
52-99	687	100	330	90
52-100	688	100	330	92
52-101	689	105	345	94
52-102	690	110	363	97
52-103	691	125	412	98
52-104	692	130	429	101
52-105	693	140	462	103
52-106	694	145	478	105
52-107	695	175	577	108
52-108	696	170	561	111
52-109	697	425	1402	113
52-110	698	775	2557	116
52-111	699	535	1765	118
52-112	700	260	858	120
52-113	730	105	345	90
52-114	731	110	363	92
52-115	732	115	379	95
52-116	733	125	412	96
52-117	734	170	561	98
52-118	735	170	561	100
52-119	736	155	511	103
52-120	737	160	528	105
52-121	738	180	594	108
52-122	739	410	1353	110
52-123	740	425	1402	112
52-124	741	350	1155	115
52-125	742	990	3267	117
52-126	743	920	3036	120
52-127	744	670	2211	122
52-128	774	125	412	120
52-129	775	130	429	95
52-130	776	135	445	97
52-131	777	140	462	98
52-132	778	230	759	100
52-133	779	375	1237	102
52-134	780	330	1089	105

Tract List (Cont'd)

NK 19-11 (cont'd)

Tract	Block	Meters	Feet	Statute Miles
52-135	781	180	594	107
52-136	782	255	841	110
52-137	783	630	2079	112
52-138	784	720	2376	114
52-139	785	790	2607	116
52-140	786	990	3267	119
52-141	787	1355	4471	122
52-142	788	1125	3712	124
52-143	818	150	495	95
52-144	819	150	495	97
52-145	820	155	511	98
52-146	821	160	528	100
52-147	822	185	610	103
52-148	823	500	1650	104
52-149	824	570	1881	106
52-150	825	350	1155	109
52-151	826	575	1897	112
52-152	827	830	2739	114
52-153	828	1040	3432	116
52-154	829	1115	3679	118
52-155	830	1325	4372	120
52-156	831	1640	5412	122
52-157	832	1600	5280	125
52-158	861	250	825	95
52-159	862	360	1188	97
52-160	863	190	624	99
52-161	864	195	647	101
52-162	865	245	808	102
52-163	866	310	1023	105
52-164	867	555	1831	106
52-165	868	1050	3465	109
52-166	869	705	2326	112
52-167	870	850	2805	113
52-168	871	1275	4207	116
52-169	872	1940	6402	118
52-170	873	1395	4603	120
52-171	874	1690	5577	123
52-172	875	2110	6963	125
52-173	876	2095	6913	128
52-174	905	560	1848	100
52-175	906	850	2805	100
52-176	907	590	1947	101
52-177	908	610	2013	104

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NK 19-11 (cont'd)				
52-178	909	590	1947	105
52-179	910	690	2277	107
52-180	911	850	2805	109
52-181	912	1390	4587	112
52-182	913	1005	3316	113
52-183	914	1365	4504	116
52-184	915	1450	4785	118
52-185	916	2075	6847	122
52-186	917	2045	6748	122
52-187	918	1860	6138	125
52-188	945	360	1188	94
52-189	946	825	2722	95
52-190	949	675	2227	100
52-191	950	1240	4092	102
52-192	951	1050	3465	104
52-193	952	975	3217	106
52-194	953	1200	3960	108
52-195	954	1145	3778	110
52-196	955	1455	4801	112
52-197	956	1725	5692	113
52-198	957	1650	5445	116
52-199	958	1675	5527	118
52-200	959	1925	6352	120
52-201	960	2190	7227	122
52-202	961	2430	8019	124
52-203	962	2325	7672	97
52-204	989	620	2046	97
52-205	990	1100	3630	98
52-206	991	1060	3498	100
52-207	992	785	2590	101
52-208	993	1310	4323	103
52-209	994	1435	4735	104
52-210	995	1450	4785	106
52-211	996	1400	4620	108
52-212	997	1715	5659	110
52-213	998	1765	5824	112
52-214	999	1915	6319	114
52-215	1000	2100	6930	116
52-216	1001	2125	7012	118
52-217	1002	2100	6930	120
52-218	1003	2200	7260	122
52-219	1005	2660	8778	126

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NK 19-12				
52-220	6	66	217	105
52-221	8	70	231	127
52-222	9	72	237	130
52-223	10	75	247	133
52-224	11	75	247	136
52-225	45	60	198	107
52-226	50	70	231	122
52-227	51	71	234	124
52-228	52	73	241	127
52-229	53	80	264	130
52-230	54	80	264	133
52-231	55	80	264	137
52-232	94	70	231	122
52-233	95	75	247	125
52-234	96	75	247	129
52-235	139	75	247	126
52-236	140	80	264	129
52-237	183	75	247	127
52-238	184	80	264	130
52-239	226	75	247	125
52-240	227	80	264	111
52-241	228	87	287	114
52-242	268	80	264	120
52-243	272	86	284	131
52-244	278	100	330	149
52-245	279	105	346	152
52-246	314	80	264	127
52-247	321	105	346	147
52-248	322	110	363	156
52-249	323	116	382	152
52-250	324	146	482	155
52-251	355	90	297	120
52-252	358	90	297	127
52-253	361	105	346	136
52-254	368	205	676	156
52-255	399	95	313	120
52-256	405	115	380	136
52-257	411	215	709	154
52-258	412	265	874	157
52-259	413	375	1237	160

Tract	Block	Meters	Feet	Statute Miles
NK 19-12 (cont'd)				
52-260	441	105	346	116
52-261	442	110	363	119
52-262	446	190	627	130
52-263	449	135	446	138
52-264	450	285	940	140
52-265	453	185	610	149
52-266	454	250	825	152
52-267	455	340	1122	155
52-268	456	550	1815	158
52-269	457	750	2475	161
52-270	485	125	412	118
52-271	486	130	429	120
52-272	487	120	396	122
52-273	488	130	429	125
52-274	489	290	957	128
52-275	490	400	1320	131
52-276	491	170	561	134
52-277	494	300	990	142
52-278	495	395	1304	145
52-279	496	230	759	148
52-280	497	395	1304	150
52-281	498	600	1980	153
52-282	499	775	2558	159
52-283	500	970	3201	158
52-284	501	1185	3910	161
52-285	502	1290	4257	164
52-286	529	155	512	119
52-287	530	150	495	122
52-288	531	180	594	124
52-289	532	146	482	130
52-290	533	160	528	130
52-291	534	410	1353	132
52-292	535	195	644	135
52-293	538	455	1502	143
52-294	539	750	2475	146
52-295	540	425	1402	149
52-296	541	740	2442	152

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NK 19-12 (cont'd)				
52-297	542	1125	3712	154
52-298	543	1275	4208	157
52-299	544	1600	5280	160
52-300	545	1825	6022	163
52-301	546	1900	6270	164
52-302	573	160	528	120
52-303	574	465	1534	122
52-304	575	325	1072	125
52-305	576	165	544	128
52-306	577	245	808	131
52-307	578	535	1766	133
52-308	579	450	1485	136
52-309	580	330	1089	139
52-310	581	445	1468	124
52-311	582	555	1832	144
52-312	583	1050	3465	147
52-313	584	975	3218	149
52-314	585	1175	3878	152
52-315	586	1495	4934	155
52-316	587	1760	5808	158
52-317	588	1875	6188	161
52-318	617	155	512	121
52-319	618	470	1551	124
52-320	619	660	2178	126
52-321	620	285	940	129
52-322	621	415	1370	132
52-323	622	845	2788	135
52-324	623	725	2392	137
52-325	624	730	2409	140
52-326	625	1010	3333	142
52-327	626	1030	3399	145
52-328	627	1350	4455	148
52-329	628	1605	5296	150
52-330	629	1680	5544	153
52-331	661	460	1518	120
52-332	662	545	1798	125
52-333	663	1075	3548	128
52-334	664	650	2145	131
52-335	665	985	3250	134
52-336	666	1155	3812	136
52-337	667	1150	3795	138
52-338	668	1045	3448	141
52-339	669	1200	3960	144
52-340	670	1400	4620	147
52-341	671	1600	5280	150
52-342	705	820	2706	125

Tract List (Cont'd)

NK 19-12 (cont'd)

Tract	Block	Meters	Feet	Statute Miles
52-343	706	1000	3300	127
52-344	707	1365	4504	127
52-345	708	775	2558	132
52-346	709	1225	4042	135
52-347	710	1825	6022	137
52-348	711	1375	4538	140
52-349	712	1375	4538	143
52-350	713	1500	4950	146
52-351	714	1695	5594	148
52-352	715	1820	6006	151
52-353	749	1210	3993	126
52-354	750	1365	4504	129
52-355	753	1420	4686	136
52-356	754	1840	6072	139
52-357	755	1675	5528	141
52-358	756	1490	4917	144
52-359	757	1725	5692	147
52-360	758	1840	6072	150
52-361	759	1995	6584	152
52-362	793	1655	5462	128
52-363	797	1690	5577	138
52-364	798	1950	6435	140
52-365	799	1830	6039	143
52-366	800	1685	5560	146
52-367	801	1825	6022	148
52-368	802	1945	6418	151
52-369	803	2090	6897	154
52-370	839	2165	7144	134
52-371	840	1950	6435	137
52-372	841	2045	6748	140
52-373	842	2225	7342	142
52-374	843	2045	6748	144
52-375	844	1790	5907	147
52-376	845	1965	6484	149
52-377	846	1940	6402	152
52-378	847	2075	6848	155
52-379	885	2325	7672	141
52-380	886	2520	8316	143
52-381	887	2425	8002	146
52-382	888	2205	7276	149
52-383	889	2160	7128	152
52-384	890	2050	6765	154
52-385	891	2100	6930	156

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NJ 19-1				
52-386	83	635	2096	93
52-387	84	600	1980	92
52-388	85	895	2954	92
52-389	119	895	2954	100
52-390	120	795	2624	100
52-391	121	860	2838	100
52-392	122	735	2426	100
52-393	123	740	2442	100
52-394	124	850	2805	101
52-395	125	1225	4042	101
52-396	126	750	2475	95
52-397	127	875	2888	95
52-398	128	850	2805	95
52-399	129	920	3036	94
52-400	130	1065	3514	94
52-401	131	925	3052	94
52-402	132	935	3086	94
52-403	163	1250	4125	104
52-404	164	1150	3795	103
52-405	165	1195	3944	102
52-406	166	1025	3382	101
52-407	167	1140	3762	100
52-408	168	1190	3927	101
52-409	169	1325	4372	99
52-410	170	1065	3514	98
52-412	171	1265	4174	97
52-413	172	1265	4174	97
52-413	173	1360	4480	97
52-414	174	1330	4389	97
52-415	175	1315	4340	97
52-416	176	1265	4174	97
52-417	209	1665	5494	106
52-418	210	1550	5115	106
52-419	211	1550	5115	107
52-420	212	1660	5478	102
52-421	213	1550	5115	102
52-422	214	1450	4785	101
52-423	215	1565	5164	100
52-424	216	1575	5197	101
52-425	217	1685	5560	100
52-426	218	1685	5560	100
52-427	219	1665	5494	100
52-428	220	1585	5230	100

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NJ 19-2 (cont'd)				
52-429	8	380	1254	89
52-430	9	320	1056	90
52-431	14	310	1023	95
52-432	15	490	1617	95
52-433	16	640	2112	97
52-434	17	825	2722	98
52-435	18	830	2739	99
52-436	19	1325	4372	101
52-437	20	1345	4438	102
52-438	21	1215	4010	104
52-439	22	1420	4686	106
52-440	23	1695	5594	108
52-441	24	1800	5940	109
52-442	25	1885	6220	111
52-443	26	1955	6452	112
52-444	27	2145	7078	115
52-445	28	1650	5445	116
52-446	36	2510	8283	134
52-447	46	395	1304	90
52-448	47	480	1584	90
52-449	53	565	1864	92
52-450	54	335	1106	93
52-451	55	405	1336	94
52-452	58	685	2260	97
52-453	59	875	2888	98
52-454	60	990	3264	99
52-455	61	1100	3630	100
52-456	62	1190	3927	102
52-457	63	1425	4702	104
52-458	64	1695	5594	105
52-459	65	1575	5198	107
52-460	66	1725	5692	107
52-461	67	1780	5874	109
52-462	76	2540	8382	127
52-463	77	2670	8811	129
52-464	80	2495	8234	136
52-465	89	700	2310	95
52-466	90	650	2145	94
52-467	91	815	2690	93
52-468	92	760	2508	93
52-469	93	655	2161	94
52-470	94	550	1815	95
52-471	95	560	1848	95
52-472	96	700	2310	95

Tract	Block	Meters	Feet	Statute Miles
NJ 19-2 (cont'd)				
52-473	97	900	2970	95
52-474	98	835	2756	96
52-475	99	850	2805	97
52-476	100	895	2954	98
52-477	101	975	3218	98
52-478	102	1150	3795	100
52-479	103	1170	3861	101
52-480	104	1225	4042	102
52-481	105	1395	4604	103
52-482	106	1425	4702	104
52-483	107	1700	5610	106
52-484	108	1825	6022	107
52-485	121	2650	8745	131
52-486	122	2525	8332	133
52-487	123	2650	8745	135
52-488	124	2550	8415	137
52-489	133	950	3135	100
52-490	134	1000	3300	100
52-491	135	1335	4406	96
52-492	136	975	3218	97
52-493	137	1205	3976	97
52-494	138	1000	3300	98
52-495	139	975	3218	97
52-496	140	1075	3548	98
52-497	141	1525	5032	98
52-498	142	1315	4340	99
52-499	143	1525	5032	100
52-500	144	1470	4851	101
52-501	145	1565	5164	102
52-502	146	1525	5032	104
52-503	147	1520	5016	104
52-504	148	1590	5247	104
52-505	149	1620	5346	106
52-506	150	1640	5412	107
52-507	165	2705	8926	132
52-508	166	2600	8580	134
52-509	167	2625	8662	136
52-510	168	2625	8662	138
52-511	177	1275	4208	99
52-512	178	1340	4422	99
52-513	179	1575	5198	99
52-514	180	1410	4653	99
52-515	181	1530	5049	100
52-516	182	1530	5049	100
52-517	183	1530	5049	100
52-518	184	1550	5164	101
52-519	185	1550	5115	113
52-520	186	1680	5544	102

Tract List (Cont'd)

Tract	Block	Meters	Feet	Statute Miles
NJ 19-2 (cont'd)				
52-521	187	1840	6072	103
52-522	188	1870	6072	104
52-523	189	1730	5709	104
52-524	212	2695	8894	140
52-525	221	1700	5610	99
52-526	222	1760	5808	104
52-527	223	1875	6188	103
52-528	224	1860	6138	104
52-229	225	1880	6204	104
52-530	226	1910	6303	104
52-531	227	1835	6056	104
52-532	228	1850	6105	104
52-533	253	2550	8415	137
52-534	254	2715	8960	139
52-535	255	2775	9158	140
52-536	256	2780	9174	143
52-537	297	2690	8877	139
52-538	298	2790	9207	140
52-539	299	2795	9223	143
52-540	300	2830	9339	145

APPENDIX B

SCOPING REPORT

APPENDIX B. SCOPING REPORT

In order to involve all affected and interested parties in defining the issues to be treated in the Environment Impact Statement, a scoping process in accordance with the requirements of Section 1501.7 of the CEQ regulations was carried out. The scoping process for the proposed Sale No. 52 EIS included meetings with the public, and with Federal, state and local officials, and analysis of written comments received in response to the Request for Resource Reports, the Call for Nominations and Comments, tract selection recommendations, and the Notice of Intent, as well as staff member's experience with identifying significant issues in the previous North-Atlantic Environmental Impact Statement and Supplement.

A Notice of Intent to prepare an Environmental Impact Statement for proposed Sale No. 52 was published in the November 13, 1980 Federal Register.

Scoping Meetings

The Notice of Intent also announced the locations and times of three public scoping meetings. These were held November 18, 1980 in Gloucester, Massachusetts, November 19 in New Bedford, Massachusetts and November 24 in Hauppauge, Long Island, New York. Sessions from 2-4 p.m. and 5-7 p.m. in Gloucester and 2-4 p.m. and 7-9 p.m. in New Bedford and Hauppauge. These meetings were publicized through special mailings to individuals and groups who had expressed an interest in being informed of coastal activities in the affected states and local government officials and radio stations. The meetings attracted state and local officials, concerned private citizens and members of environmental and civic groups, with 25 to 30 people attending each session in Gloucester and New Bedford, and 8 people per session in Hauppage. The New York OCS Office was represented at Gloucester and New Bedford by the Chief of Environmental Assessment Division, Public Information Officers and staff from the Environmental Assessment Division. In Hauppage, the OCS Office was represented by the Assistant Manager and staff members of the Environmental Assessment Division.

Three persons submitted written comments at these meetings. They were from the State of Massachusetts, Friends of Long Island, and the Office of the Honorable Nicholas Mavroules. All proceedings were taped so that there is a record of all oral comments.

Many of the comments and questions raised at these meetings required additional responses. For instance, many people were interested in who is responsible for cleaning up oil spills and how the Offshore Oil Pollution Compensation Fund is managed. Information on these subjects is provided in the EIS, but such questions do not directly identify significant issues to be covered in the EIS.

Analysis of all oral comments at these meetings showed that public concern focused on fisheries issues, such as compensation, impacts from OCS related debris in the water and oil spill impacts on fisheries.

These issues, along with those identified as significant in other parts of the scoping process, received detailed treatment in the EIS. Table B-1 of this appendix summarizes and categorizes the comments received from all phases of the scoping process.

A scoping meeting for federal and state officials was held on December 8, 1980 in Providence, Rhode Island in conjunction with a meeting of the Intergovernmental Planning Program's North Atlantic Technical Working Group. This group has been involved in proposed Sale No. 52 since pre-tract selection and has responded at earlier stages of the leasing process with scoping issues. The Manager's Environmental Briefing for proposed Sale No. 52 was held in New York on April 16-17, 1980 in conjunction with a meeting of this group and the member's recommendations on tract selection stemming from this October meeting have been evaluated as part of the scoping process. Three significant areas of concern were identified. These were:

--Impacts on commercial fisheries
--Deep water technological capabilities/geohazards
--Transportation of oil and gas from the proposed Sale

These areas also received treatment in the EIS.

At the December 8th scoping meetings, the concerns mentioned at the April meeting were reiterated. In addition, transportation scenarios were discussed and possible sites for pipeline landfalls to be used in the EIS to assess impacts.

The following federal agencies, states, and organizations have members on the North-Atlantic Technical Working Group who attended both the October and the May meetings.

Bureau of Land Management
Geological Survey
Fish and Wildlife Service
Environmental Protection Agency
National Oceanic and Atmospheric Administration

American Petroleum Institute
Interstate Natural Gas Association
New England Fishery Management Council
Chatham Seafood Cooperative
Assoc. Preservation of Cape Cod
Scientists Inst. for Public Information
National Wildlife Federation
Private Consultant

Maine
New Hampshire
Massachusetts
Rhode Island
Connecticut

New York
New Jersey

Development of Alternatives

Comments received prior to tentative tract selection in Resource Reports, comments of concern and negative nominations received in response to the Call for Nomination and Comments, and the IPP members tract selection recommendations were reviewed to ascertain areas requiring study in the EIS. This review helped develop the alternatives described in Section II.

Summary

Because of the significant issues raised which led to the development of the alternatives, the potential environmental impacts of all aspects of oil and gas leasing on these alternatives are assessed in this EIS. In addition, information on other areas brought out through scoping, but not directly related to the impact assessment, are included in the EIS. Table B-1 is a summary of the Scoping issues for the proposed Sale including area of concern raised by Federal agencies, states, private organizations and concerned individuals.

Table B-1. **SALE NO.52 SCOPING ISSUES**

	Atlantic Offshore Fishermen and Lobstermen Association	North Atlantic Regional Technical Working Group	U.S. Department of Defense (DOD)	U.S. Coast Guard (USCG)	Audubon (Massachusetts)	Manager's Briefing for Tract Selection	Fish and Wildlife (Tract Selection)	U.S. Department of Commerce (DOC), NOAA	Congressman Mavroules	Gloucester, Mass. Public Scoping Meeting	New Bedford, Mass. Public Scoping Meeting	Hauppauge, N.Y. Public Scoping Meeting	Commonwealth of Massachusetts	State of New York	State of Rhode Island	Conservation Law Foundation	Gloucester Fisherman's Wives Association	Nantucket Land Council
Delete tracts deleted in Sale No. 42	●				●					●	●		●			●		●
Apply Best & Safest Available Technologies (BAST)		●							●	●		●	●			●		●
Delete tracts in canyons and canyon heads	●	●				●	●	●		●	●	●	●			●		●
Use of dispersants: benefits & shortcomings		●																
Georges Bank Gyre (Crest of the Bank) and oilspills	●					●	●			●	●		●					
Seasonal windows as related to oil and gas activities & characteristic weather		●								●								
Delay Sale No. 52 until results from Sale No. 42 are available	●	●			●			●	●	●	●					●	●	●
Deletion of all tracts between the 200 and 2000 meter depth contours, the Slope		●																
Mobile Bedforms: geohazards, slumping						●		●			●	●	●	●	●			
Pipeline to New Jersey vs tankers to New Jersey		●																
Delete tracts closer than 50 miles from shore					●	●	●		●	●	●		●			●		●
Onshore disposal of drilling muds and cuttings		●																
Oilspill cleanup capabilities		●				●			●	●	●					●		●
The effects of drill muds and cuttings										●	●	●						●
As part of the scenarios consider a gas pipeline landfall in Barnstable County, Mass.		●																
Consider New York Harbor facilities for support bases		●																
Conflict with military activities (submarines and Air Force)			●															
Conflict with shipping lanes (vessel traffic)	●			●	●	●	●			●			●	●	●	●		●

Table B-1 (cont'd)

SALE NO. 52 SCOPING ISSUES

	Atlantic Offshore Fishermen and Lobstermen Association	North Atlantic Regional Technical Working Group	U.S. Department of Defense (DOD)	U.S. Coast Guard (USCG)	Audubon (Massachusetts)	Manager's Briefing for Tract Selection	Fish and Wildlife (Tract Selection)	U.S. Department of Commerce (DOC), NOAA	Congressman Mavroules	Gloucester, Mass. Public Scoping Meeting	New Bedford, Mass. Public Scoping Meeting	Hauppauge, N.Y. Public Scoping Meeting	Commonwealth of Massachusetts	State of New York	State of Rhode Island	Conservation Law Foundation	Gloucester Fishermen's Wives Association	Nantucket Land Council
No. of tracts in Proposed Sale No. 52 is four times greater than maximum in the Five Year Plan					●													
Data from the North Sea oil and gas operations should be used in the analysis										●	●							
Debris on the bottom and its impact on fisheries (Debris related to oil and gas operations mentioned as great problem in the North Sea)					●					●	●	●						
Technological capabilities in the deepwaters of the Proposed Sale area		●			●	●	●											
General concerns about oilspills and their impact: spawning, fish population and fishing industry					●	●	●		●	●	●	●	●	●		●		●
Impact of the Proposed Action on Endangered Species						●		●				●			●			
Oilspills and their impact on recreation and tourism						●				●	●	●		●				●
Impacts of oil spilled at the frontal zone													●					
As a mitigating measure consider further offshore barging of drill muds and cuttings									●	●	●							
As a mitigating measure consider reinjection of formation waters									●	●								
Compensation for losses due to oilspills: tourism and fishermen										●	●	●				●		
Fish (renewable food source) vs Fuel (finite resource)										●								●
Special exclusion: its impact on fisheries										●	●		●					
Generally opposed to offshore drilling										●		●						
Amend Lands Act to evaluate entire region/system											●							
Delete tracts in herring spawning and fishing grounds															●			
Impact on tilefish fishing grounds								●										
OCS oil & gas impact on air quality (Air Pollution)																		●

APPENDIX C

EXPLANATION OF ASSUMPTIONS

Appendix C. Explanation of Assumptions

Since the pattern of future OCS development cannot be predicted with certainty at this time, certain assumptions must be made to allow impact analysis to be performed. These assumptions are the basis of the scenarios developed in this impact statement. They are not development plans or proposals but are believed to represent reasonable patterns of development which could occur as a result of this sale. This section describes these assumptions and why they have been chosen.

Resources

Conditional resource estimates have been assumed in this EIS rather than risked estimates. Risked estimates allow for the possibility that no recoverable hydrocarbons will be discovered. Risked resource estimates are used by industry and government analysts to assess the dollar bid value of undiscovered oil and gas in a tract. However, since risked estimates are lower than conditional estimates, the use of risked estimates for environmental assessment would understate the actual impacts which should be expected if commercial oil and gas were discovered as a result of this proposed sale. Therefore this EIS is based upon conditional estimates. The main scenario is based on the conditional mean resource estimates (Section II.B.1) for proposed Sale No. 52, while the high and low scenarios (Section IV.D) are based on the fifth and ninety-fifth percentiles of the conditional distribution, respectively. Thus, if a commercial discovery is made, there is only once chance in twenty that the amount will be less than the low estimate or higher than the high estimate.

Offshore Structures

The number and scheduling of platforms, wells, pipelines, and other offshore equipment has been provided by the U.S. Geological Survey, based upon the resource production expected in each scenario. (Sections II.B.1 and IV.D.)

Transportation Routes and Locations of Processing and Refining Baseline Condition

Before development scenarios can be generated for a given area, prior development (whether assumed or actually in progress) must be identified and examined. This prior development, called the baseline condition, is that activity which is assumed to occur whether or not this proposed sale occurs. For Proposed Sale 52 this "baseline condition" would be that activity generated from development of tracts leased in Sale 42 in the North Atlantic, Sales 40 and 49 in the Mid Atlantic, and assumed activity that could be generated from Proposed Sale 59 in the Mid-Atlantic.

Sale No. 42

Based on the most recent conditional mean resource estimates, one gas pipeline has been assumed to result from Sale 42. Offshore this pipeline could follow a route similar to the southern gas pipeline route examined in the Sale 42 FEIS. It is assumed to landfall on the southern shore of Little Compton, and Rhode Island and travel onshore to a hypothetical gas facility in the Fall River area of Bristol County, Mass. There, it has been assumed, it could be treated, dehydrated, processed, and then injected into the existing natural gas transmission system. It has been assumed that oil discovered in the Sale 42 area will be transported via tankers to refineries in Northern New Jersey.

Sales 40 and 49

A two-phase pipeline has been assumed as the mode of transport for the oil and gas discovered in the sale 40 and sale 49 areas. Offshore, it has been assumed to follow a straightline route beginning near an area of high exploratory interest (NJ18-3, Block 598) and proceed in a straight line to a landfall at Island Beach State Park, New Jersey. Onshore, it could continue to a small separating facility hypothesized for construction in Berkley Township, Ocean County. The oil, it has been assumed, is then carried by truck or rail to an existing Perth Amboy refinery and the gas piped to West Windsor Township, Mercer County, where treatment, dehydration, and processing could be carried out. (See FEIS 59 for further detail.)

Proposed Sale No. 59

It is hypothesized that Proposed Sale 59 could add two more gas pipelines with two related gas facilities, and one oil pipeline with a related tank farm to the assumptions thus far. Offshore, the northernmost of the two gas pipelines would proceed to the same landfall as the 40/49 two-phase pipeline. Onshore it could follow the 40/49 ROW (Right-of-Way) to another gas facility at the same site in Mercer County, NY. It has been assumed that the gas from the southern gas pipeline which is assumed to come ashore near Sea Isle City in Cape May County, NJ, could be processed, dehydrated, and treated within a few miles of the landfall. It has been assumed that oil from proposed Sale 59 could be transported by a single large diameter pipeline making a landfall in Atlantic City and transporting this oil further onshore to refineries in New Jersey and across the Delaware River to refineries in Pennsylvania. (See FEIS 59 for further detail)

Proposed Sale No. 52

The scenarios hypothesized for Proposed Sale 52 have been developed under the constraints of the previously described prior and proposed sale assumptions. Assumed prior facility commitments (i.e. use of refinery space) and prior routing assumptions underlie the assumptions made for the Proposed Sale No. 52 scenarios.

Mean Case

Pipelines have been assumed as the mode of transportation for the Proposed Sale 52 mean scenario gas discoveries. Alternate concepts for transporting natural gas, such as converting the natural gas offshore to either methanol (petrochemical intermediate), ammonia (fertilizer), or liquified natural gas (LNG) and tankering, or using the gas to generate electricity offshore, and transmitting the electricity to shore by cables, have not been assumed due to economic infeasibility, and/or, the fact that they are still in various stages of design and have not yet been implemented in offshore operations. Therefore, gas discoveries made in the mean estimate for the Proposed Sale 52 area have been assumed to be collected by numerous small diameter gathering lines which connect with the nearest of the two 36" trunklines necessary to transport the peak gas production. Both of these trunklines could then follow an offshore route similar to that assumed to result from Sale 42 to a landfall on the southern shore of Little Compton, Rhode Island. This route, as portrayed on Figure II.B.1.a-1, is not a straight line to shore. Although, due to the generally higher cost per mile of offshore pipeline installation versus onshore pipeline installation, a straight line route to the point onshore nearest to the offshore production site would be the economically preferred mode of pipeline selection, some deviation often occurs. This deviation may be caused by a number of environmental or conflicting land use restrictions. Therefore, the offshore pipeline routes selected for these scenarios are not always the shortest routes possible but reflect possible constraints that could increase pipeline length such as landfall restrictions and geological factors.

The choice of an onshore pipeline route is a complex decision as well, based on the consideration of a number of preferences and constraints. When choosing a route, a balance must be achieved between environmental, technical, legal, economic, and social considerations. These factors will influence the route chosen, the techniques used, the mitigating measures employed, and the timing of the construction activities. Such a decision is not arbitrary or predictable, but a complex problem that will be solved as part of the overall development strategy after exploration has proved recoverable resources. Due to the complicated nature of such a decision, and the fact that this is not a problem with a single absolute solution, instead of choosing one "most likely" route to examine in this impact statement, an area, within which it has been assumed the ROW could be chosen, has been identified and examined. It is believed that this approach should supply some generic examples of onshore pipeline impacts without unfairly limiting the scope, and thus the value of this impact analysis.

The general area assumed is that area depicted on Figure II.B.1.a-1. Too much deviation from this general area could cause a pipeline to become economically unfeasible. It assumes the pipelines could travel north of the Little Compton landfalls, through Tiverton and Westport, in order to

terminate at the hypothetical gas facility in the Fall River area, Bristol County, MA. In open country, as a reaction to the problems of liability, maintenance, and mitigation of safety problems that may be encountered with a shared ROW, there is an industry preference towards developing a new ROW, perhaps adjacent to an existing ROW. In a metropolitan area, where space may be at a premium, it may be necessary to utilize existing ROWs. Some existing ROWs that could be considered for paralleling or utilization in the identified area are: state highways 77, 88, and 177, existing pipeline ROWs, telephone cables, and power transmission lines. Each of these types of existing ROW has associated positive and negative aspects.

When an actual decision is to be made, preferences of all levels of government will have to be considered. Specifically, a permit from the Rhode Island Coastal Resources Management Council would be required before the actual siting and construction of any pipeline could occur in or across the land and/or tidal water bodies of the Rhode Island coastal region (R.I. CZM) and approval must be received from the Massachusetts Energy Facility Siting Council for any pipeline siting in Massachusetts (Mass. CZM). The Federal Energy Regulatory Commission (FERC) has primary federal jurisdiction over gas companies transporting or selling natural gas in interstate commerce, so that the construction of any gas pipelines and facilities necessary to transport any gas produced on the OCS would be subject to FERC review and approval.

Due to the present lack of natural gas facilities in the New England area, it has been assumed that a gas facility would have to be constructed. This hypothetical gas facility could be located in the Fall River area, near Freetown at the termination point of the hypothetical pipelines. This area was chosen due to its positive attitude towards development, available acreage, and proximity to gas infrastructure. The nature of this gas facility, as with any gas facility, is dependent upon the composition of the gas that must be dealt with. Dry, low sulfur gas would need virtually no dehydration, processing or treatment prior to entrance into the existing gas transmission system. Wet, high sulfur gas may require extensive dehydration, processing and treatment. It has been assumed in this statement, for the sake of worst case analysis, that some degree of dehydration, processing and treatment will be necessary before any of the OCS gas production may enter the existing transmission system. Any gas facility site actually considered in Massachusetts would be subject to review and approval by the Massachusetts Energy Facilities Siting Council on the state level and FERC on the federal level.

Due to the lack of major refineries or approved refinery proposals in the New England area, as well as the expense of piping the oil from the sale area to any existing refineries, it has been assumed in the mean case that oil will be tankered. It has been assumed that these tankers could transport this oil via existing tanker routes to the refineries on the Raritan and Delaware Bays, where it is expected, for the most part, to replace imported oil over the long-term.

High Case

Two large diameter (42") offshore pipelines have been assumed to be necessary to transport the the quantity of gas estimated, at the rate of production expected, from the proposed Sale 52 high find. Rather than assuming both pipelines would follow the same route, the high case was taken as an opportunity to assess the impact of an alternate routing possibility. Half the gas production is assumed to be collected by small diameter gathering lines and follow the same route both offshore and onshore as that described for the mean case (see Figure II.B.1.a-1 and mean description); and half, it has been assumed, could be collected and join a trunkline which will follow a more northern route to a closer landfall, the southern shore of Barnstable Co., MA. This northern hypothetical pipeline, prior to land-falling in the Barnstable area of Cape Cod, has been assumed to traverse the Cape Islands Ocean Sanctuary, which is subject to the Massachusetts Ocean Sanctuaries Regulations, (which precludes "the building of any structure on the seabed or under the subsoil") and the central Nantucket Sound, which is currently on NOAA's List of Recommended Areas for Marine Sanctuary designation. During the permitting process FERC will have to take into account these and any other state and local laws, as well as the statement of any party who successfully petitions to intervene, at a public hearing on the certification. The general onshore area within which it has been assumed, the northern pipeline ROW could be chosen is depicted on Figure IV.D-1. Using the rationale employed for siting the pipelines in the 52 mean scenario section, one specific "most likely" ROW was once again not assumed. It has been assumed that this pipeline will travel northeast from its Barnstable landfall, through Barnstable, Sandwich, Borne, Plymouth and Wareham, to its termination point in the Carver, Middleborough area of Plymouth County. Some existing ROWs that could be considered for parallel-ing or sharing in the identified area are state highways 25, 28, and 132, U.S. Highway 6, Penn Central Railroad, existing power transmission lines, telephone cables, and pipelines. Any pipeline route traversing this area would be subject to the review and approval of the Massachusetts Energy Facilities Siting Council and FERC.

It has been assumed that two gas facilities could be necessary to process, dehydrate, and treat the quantity of gas assumed to be discovered in the High Case. It has been assumed that one hypothetical gas facility could be located in the Fall River, area, near Freetown at the point of termination of the southern pipeline (as in the mean scenario), and the other could be located in the Carver, Middleborough area at the point of termination of the northern pipeline. The Carver, Middleborough area was selected due to its positive industrial climate, and available acreage. Both facilities would be subject to review and approval by the Massachusetts Energy Facilities Siting Council and FERC.

It has been assumed that oil production, which in the peak year high case estimate exceeds the capacity of refineries in both the Raritan and Delaware Bays, could be transported via tanker to not only these Mid-Atlantic refineries, but, during peak years, to those of the Gulf of Mexico region as well.

Low Case

It has been assumed in the low scenario that gas finds will be reinjected and/or consumed on the platforms. These are currently the most economic alternatives for the quantity of gas anticipated in the low scenario. Oil, it has been assumed, could be transported by tanker, via existing tanker routes to refineries in the Raritan Bay area.

Other Infrastructure

Compressor Stations

Due to the long distances the pipelines must span, and the assumed gas characteristics, it has been assumed that compressor stations could be necessary to ensure smooth movement within the gas pipelines. It has been assumed that these compressor stations could be located along the pipeline route on an offshore platform.

Pipecoating Yards

Though coating of the pipe could occur at a number of coastal locations, the expected quantity of work generated due to proposed Sale No. 52, as well as the ability of existing yards to meet the required delivery schedule of the oil and gas industry assumed for this sale, imply that pipecoating activity could be accomodated by existing yards. An existing pipecoating yard in Fairless Hills, Pennsylvania has been assumed for this activity since this yard is equipped to use the "impingement" coating process, which provides the flexibility required when installing an offshore pipeline. From there, the coated pipe could be transported to either the operations support base or the offshore area.

Platform Fabrication

It has been assumed that platform fabrication and subsea complex construction for proposed Sale No. 52 could occur at existing yards in the Gulf of Mexico region, from which they could be shipped to the offshore area. This assumption was based on 1) the fact that there are currently no existing platform fabrication yards or subsea complex construction areas on the East Coast, nor any active proposals to set up either and 2) the USGS estimates of the schedule of production imply that it may be more feasible to ship these platforms and subseas from existing yards than set up new ones, especially since the establishment of new construction facilities involves the consideration of many factors such as overall worldwide demand for platforms and subseas, existing capacities for construction, competitive position of individual companies, and the pace of OCS leasing in both the Mid- and North Atlantic.

Operations Support Bases

Many factors must be considered before the selection is made for an operations support base. Some basic selection criteria which underlie the support base assumptions made are: proximity to sale area, costs to establish and operate a base in that particular area, land availability, public attitude, available harbor facilities with a minimum draft of 15 to 20 feet at low tide, social infrastructure, and access to industrial infrastructure such as railroad lines, highways, and warehouse space (NERBC, 1976). Quonset-Davisville in the Washington County, Rhode Island area fulfills the basic criteria and has been assumed as the site for the majority of the operations support activity assumed necessary in the Proposed Sale 52 mean scenario. Based on this same mean level of activity, it has been assumed that other harbors could be used for operations support. Due to its proximity to the southwestern tracts of the proposed sale, the Stapleton Piers area of Richmond County, New York has been assumed to be likely location for a lesser degree of support activities. It is possible that some degree of reconstruction could be necessary before the Stapleton Pier area can be utilized.

In the high scenario, an additional support base may be required. It has been assumed that such an additional site could be located in the Portsmouth area of Rockingham County, New Hampshire.

In the low scenario, due to the lesser degree of estimated development, it has been assumed that all exploration, development, and production could be supported from the Quonset-Davisville area.

Helicopter Support

It has been assumed that Helicopter support will be provided from Barnstable Municipal Airport, on Cape Cod. This assumption was made based on the airports proximity to the proposed sale area, prior support of the first Georges Bank COST (Continental Offshore Stratigraphic Test) well, and its willingness and ability to expand their services to accomodate OCS traffic.

Conclusion

All scenarios developed for this impact statement are hypothetical development scenarios and as such are not be be interpreted as predictions or plans for future site specific development. It is believed, however, that the assumptions made here do represent reasonable patterns of development that could be associated with the proposed sale in this region, and are therefore a valuable tool in the identification and analysis of the types of impacts possible. It is possible that routes and sites assumed here will be found unacceptable by state and local governments. When the development stage is reached and actual sites are being evaluated, all facilities will be sited in accordance with applicable laws and will go through the necessary federal, state, and local permit processes to ensure that acceptable sites are chosen and adverse impacts are mitigated.

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APPENDIX D

OIL SPILL RISK ANALYSIS

DRAFT

AN OILSPILL RISK ANALYSIS FOR THE NORTH ATLANTIC (PROPOSED SALE 52) OUTER CONTINENTAL SHELF LEASE AREA

By Robert P. LaBelle and Kenneth J. Lanfear

Abstract

An oilspill risk analysis was conducted to determine the relative environmental hazards of developing oil in different regions of the North Atlantic (Proposed Sale 52) Outer Continental Shelf (OCS) lease area. The probability of spill occurrences, likely movement of oil slicks, and locations of resources vulnerable to spilled oil were analyzed. The times between spill occurrence and contact with various resources were also estimated. The combined results yielded estimates of the overall risks associated with development of the proposed lease area. Assuming that oil exists in the lease area (a 40-percent chance) and depending upon the routes chosen to transport oil from OCS platforms to the shore, the leasing of the tracts proposed for OCS Sale 52 will result in an expected 10.2 oilspills (of 1,000 barrels or larger). The estimated probability that land will be contacted by one or more oilspills (of 1,000 barrels or larger) that have been at sea less than 30 days is 0.71. If existing transportation of oil in the area is considered, this probability increases greatly, to more than 0.99.

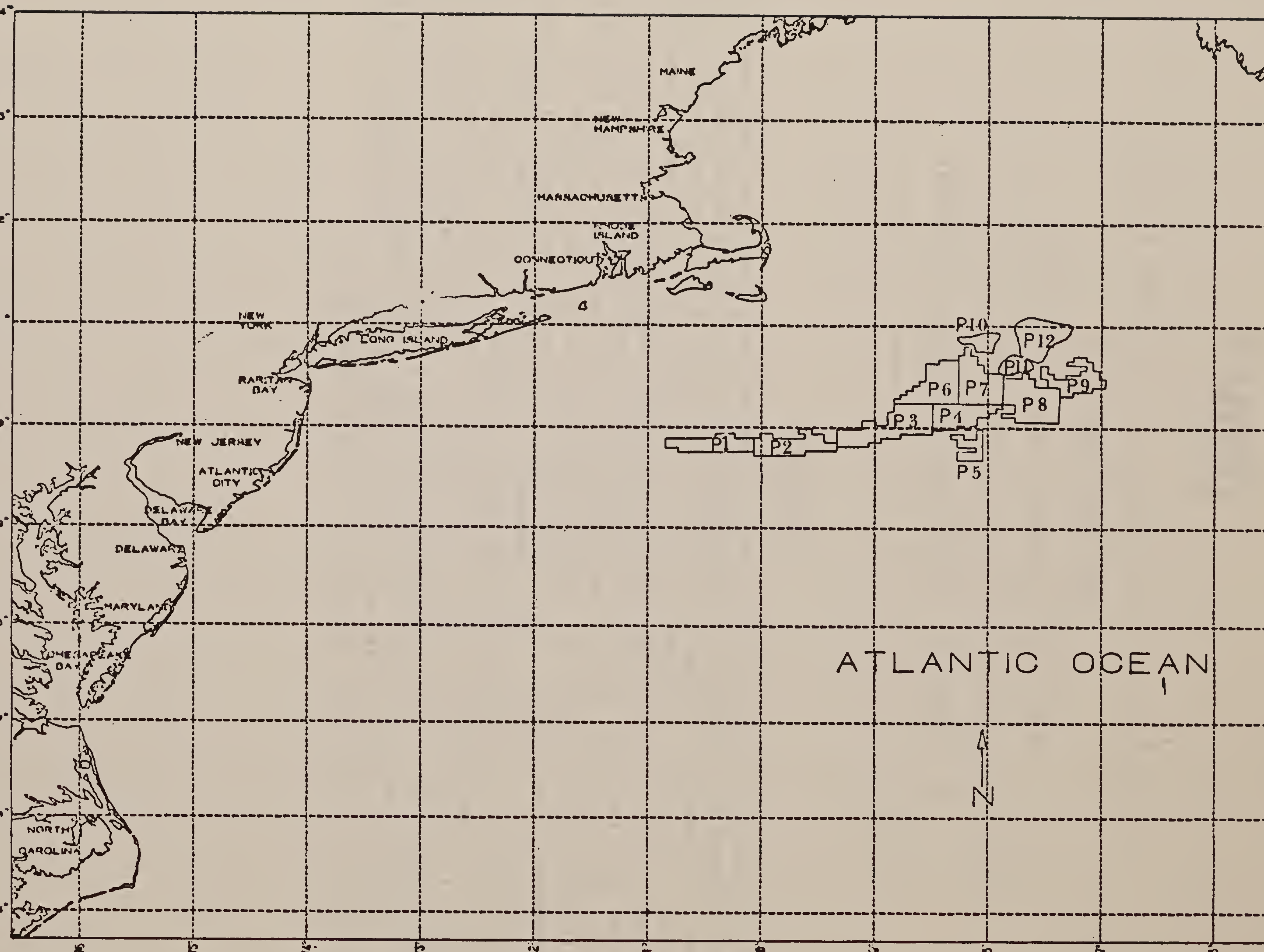

Figure 2.--Map showing the subdivisions of the proposed lease tract groups for North Atlantic OCS Lease Sale 52.

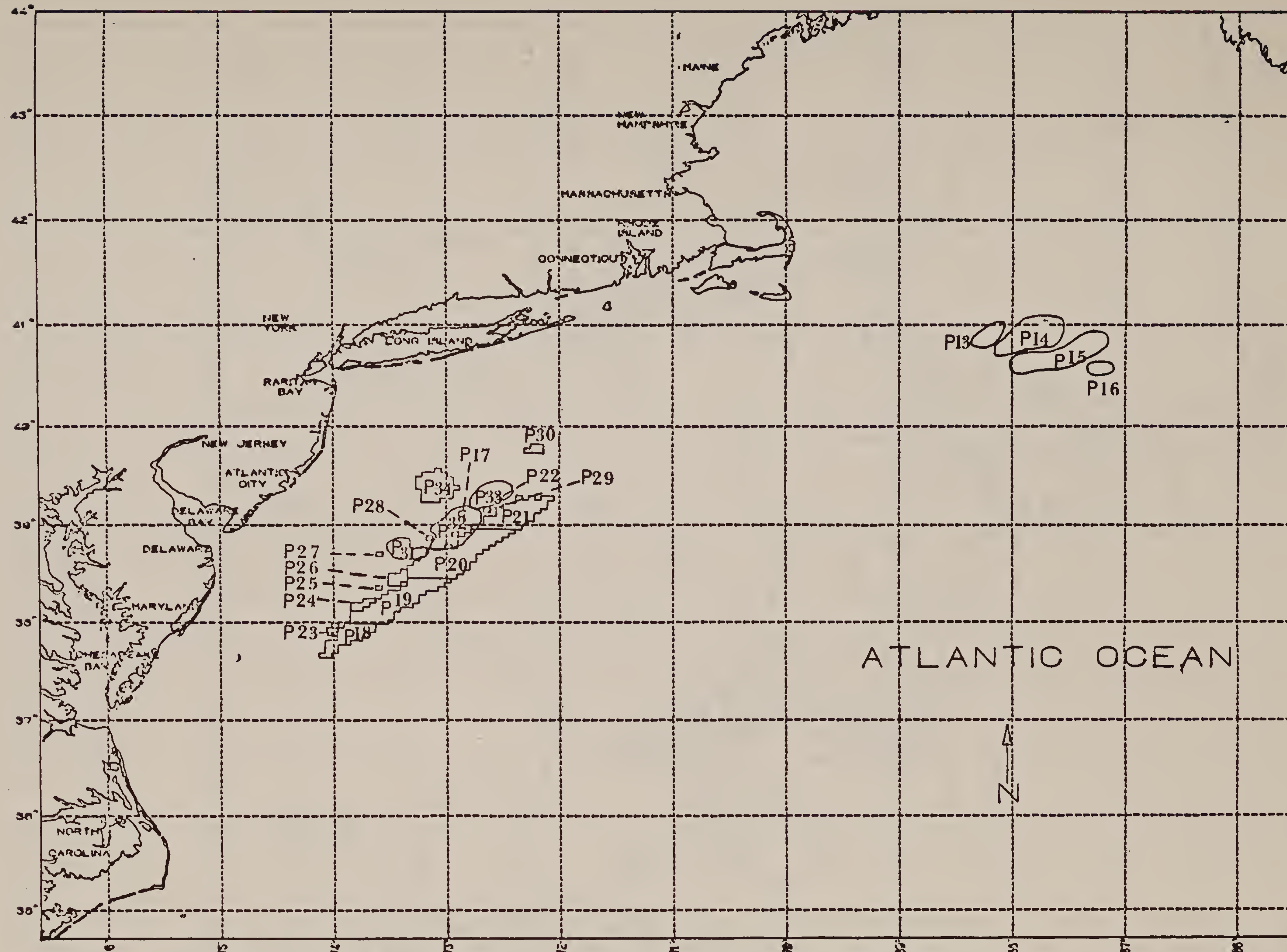

Figure 3.--Map showing the subdivisions of the existing lease tract groups in the study area and tract groups (P17-P22) to be offered in OCS Sale 59.

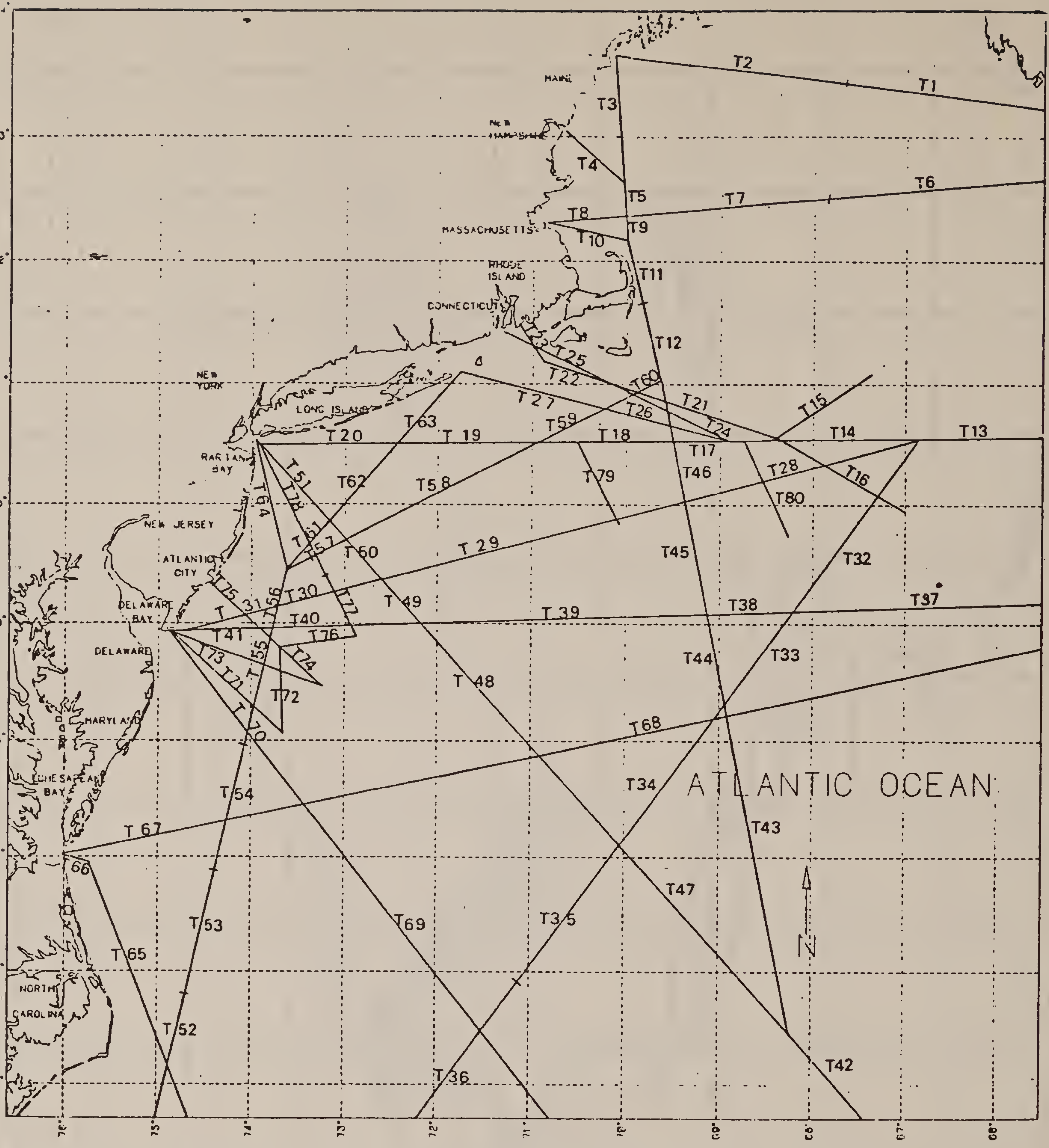

Figure 4.--Map showing the transportation route segments (T1 to T80).

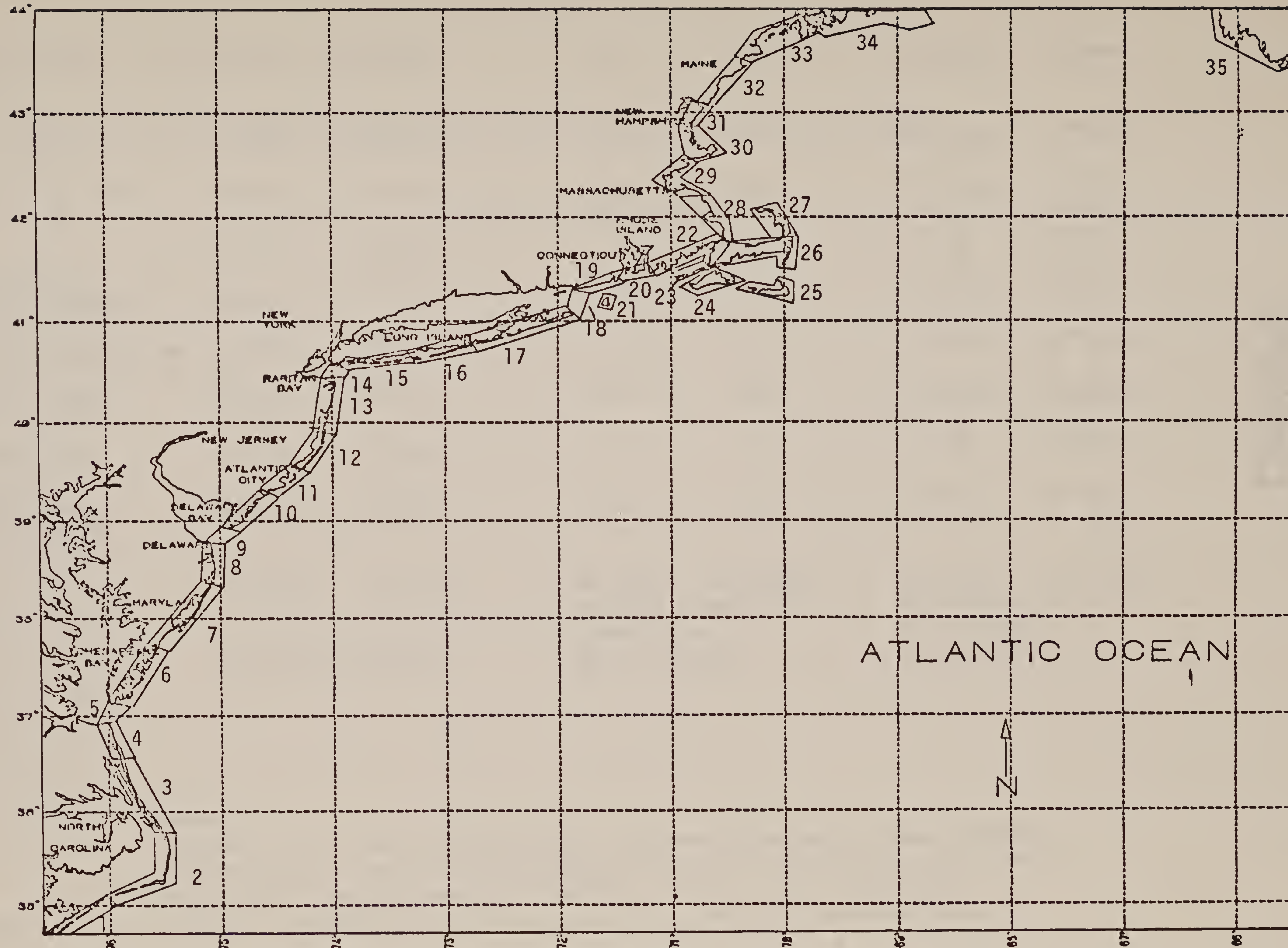

Figure 5.--Map showing the division of the North Atlantic shoreline into 35 segments of approximately equal length.

Table 1. -- Oilspill probability estimates for spills greater than 1,000 and 10,000 barrels resulting over the expected production life of OCS Lease Sale 52, from existing Federal leases, or from existing oil transportation in the study area.

	Expected number of spills (mean).		Most likely number of spills (mode).		Probability of one or more spills	
	>1,000	>10,000	>1,000	>10,000	>1,000	>10,000
Proposed action (Sale 52, mean)	10.24	5.59	10	5	0.99+	0.99+
(Sale 52, low)	0.10	0.05	0	0	0.09	0.05
(Sale 52, high)	30.23	16.07	30	16	0.99+	0.99+
(Sale 52, 0-2,000 m)	9.41	5.14	9	5	0.99+	0.99+
(Sale 52, >200 m)	8.41	4.59	8	4	0.99+	0.99
Sale 42	1.14	0.62	1	0	0.68	0.46
Sales 40, 49, 59	13.27	4.70	13	4	0.99+	0.99
Sales 52 and 42	11.38	6.21	11	6	0.99+	0.99+
Existing transportation	93.41	55.85	93	55	0.99+	0.99+

DRAFT

Table 3. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location																								
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Land	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Waterbirds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Duck Wint. Areas	n	n	n	n	n	1	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	n	n	n	n	n	12	10	n	1	**	6	30	99	62	13	2	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 3. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location																								
	P26	P27	P28	P29	P30	P31	P32	P33	P34	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
Land	n	n	n	n	n	n	n	n	n	15	12	13	17	6	n	2	29	18	43	35	17	n	n	n	n
Coastal Waterbirds	n	n	n	n	n	n	n	n	n	n	8	10	17	1	n	n	8	1	7	6	3	n	n	n	n
Sea Duck Wint. Areas	n	n	n	n	n	n	n	n	n	n	5	3	3	3	n	n	18	5	23	15	59	n	n	n	n
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	3	1	n	n	n	n	n	n	n	n	n	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	2	3	2	n	n	n	2	1	3	3	7	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n
Hard Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	4	n	1	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	1	4	8	1	n	n	8	1	8	n	1	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n	n	1	n	n	5	5	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	13	18	28	8	n	1	45	15	55	37	7	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	17	13	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	n	1	3	4	1	n	n	8	1	11	n	n	n	n	n	n
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	1	13	16	22	22	n	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	5	6	14	1	n	n	8	n	8	n	n	n	n	n	n
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	6	6	7	n	n	n	n	n	n	4	7	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	1	6	1	n	n	1	1	1	22	n	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	3	11	9	n	3	29	31	54	96	32	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	1	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	11	17	6	n	1	18	7	19	23	20	n	n	n	n
Georges Bank Crest	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	3	n	n	n	n	1	n	8	35	2
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 3. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40	T41
Land	n	n	n	10	n	19	68	1	40	1	8	n	n	n	9	n	n	n	n	n	n	n	n	n	8
Coastal Waterbirds	n	n	n	9	n	8	36	n	18	n	5	n	n	n	9	n	n	n	n	n	n	n	n	n	9
Sea Duck Wint. Areas	7	8	n	19	24	56	58	40	57	39	23	n	n	n	8	n	n	n	n	n	n	n	n	n	9
Osprey Nesting Areas	n	n	n	n	n	7	12	n	11	n	2	n	n	n	1	n	n	n	n	n	n	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	8	21	n	15	n	3	n	n	n	1	n	n	n	n	n	n	n	n	n	2
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	5	n	n	7	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	8	n	17	18	n	21	n	4	n	n	n	9	n	n	n	n	n	n	n	n	n	9
Soft Clam Grounds	n	n	n	n	n	3	12	n	5	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	5	4	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	20	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	1	64	n	23	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	6	n	n	24	n	9	n	1	n	n	n	6	n	n	n	n	n	n	n	n	n	6
Natl. Parks, Seashr.	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Parks, Seashr.	n	n	n	8	n	n	34	n	13	n	6	n	n	n	1	n	n	n	n	n	n	n	n	n	1
Natl. Wildlife Refs.	n	n	n	n	n	n	8	n	9	n	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	22	n	7	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	n	n	n	n	1	53	**	4	73	2	16	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	4	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	1	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	14	n	n	n	23	n	n	6	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	14	n	n	n	3	n	n	n
Gulf Stream Seg. 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	19	2	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

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Table 3. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location																							
	T42	T43	T44	T45	T46	T47	T48	T49	T50	T51	T52	T53	T54	T55	T56	T57	T58	T59	T60	T61	T62	T63	T64	T65	T66
Land	n	n	n	n	n	n	n	n	n	6	n	n	n	n	n	n	n	n	3	1	n	13	14	9	38
Coastal Waterbirds	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	1	n	.2	5	3	5
Sea Duck Wint. Areas	n	n	n	n	31	n	n	n	n	4	n	n	n	n	n	n	n	7	55	n	n	20	9	n	19
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	3
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	1	1	2	3
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	4	1	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	3	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	1
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	35
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	6	2	n	5
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	3	n	4
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	9	2	3	8
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	3	16	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
Georges Bank Crest	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	29	n	n	n	n	n	n	n	n	n	n	n	n	8	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	32	1	n	n	n	n	n	n	n	n	n	n	n	12	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	8	10	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 3. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location													
	T67	T68	T69	T70	T71	T72	T73	T74	T75	T76	T77	T78	T79	T80
Land	9	n	n	2	5	n	4	n	10	n	n	15	n	n
Coastal Waterbirds	4	n	n	2	3	n	4	n	9	n	n	4	n	n
Sea Duck Wint. Areas	6	n	n	6	9	n	6	n	n	n	n	9	n	n
Osprey Nesting Areas	3	n	n	n	1	n	n	n	1	n	n	1	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	4	n	n	n	n	n
Pereg. Falc. Migr.	1	n	n	1	1	n	1	n	3	n	n	n	n	n
Logg. Turtle Nest.	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	2	4	n	4	n	2	n	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	1	n	n
Oyster Grounds	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	5	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	1	n	n	2	4	n	3	n	1	n	n	2	n	n
Natl. Parks, Seashr.	n	n	n	n	1	n	n	n	n	n	n	5	n	n
State Parks, Seashr.	n	n	n	1	2	n	1	n	n	n	n	1	n	n
Natl. Wildlife Refs.	8	n	n	n	n	n	n	n	9	n	n	1	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	9	n	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	4	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	n	n	n	n	n	n	n	n	n	n	n	n	n	3
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	2	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	10	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	4	1	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	17	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	15	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

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Table 4. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	Hypothetical Spill Location																								
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Land	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Waterbirds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Duck Wint. Areas	n	1	1	n	n	3	2	n	n	3	1	1	4	2	n	n	n	n	n	n	n	n	n	n	n
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	1	1	4	3	n	24	20	4	6	**	17	42	99	69	24	8	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	1	1	1	n	1	1	1
Gulf Stream Seg. 5	4	4	2	1	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	5	9	10	10	17	4	5	7	5	1	4	1	1	1	2	3	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

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Table 4. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	P26	P27	P28	P29	P30	P31	P32	P33	P34	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
	Hypothetical Spill Location																								
Land	n	n	n	n	n	n	n	n	1	39	19	26	32	23	8	8	51	31	61	45	29	n	n	n	n
Coastal Waterbirds	n	n	n	n	n	n	n	n	1	n	12	16	21	4	n	1	10	3	11	8	7	n	n	n	n
Sea Duck Wint. Areas	n	1	n	n	n	n	n	n	n	n	8	8	10	11	n	3	27	13	29	23	60	n	1	2	1
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	3	1	n	n	n	n	n	n	n	n	1	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	3	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	3	6	4	2	n	1	4	3	5	6	11	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	3	n	n	n	n
Hard Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	7	2	7	1	4	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	2	8	13	4	n	n	11	2	11	1	2	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	5	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	1	6	1	n	1	2	1	2	7	7	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	17	30	42	20	n	6	57	24	63	42	10	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	21	15	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	n	1	6	7	3	n	n	11	2	13	n	n	n	n	n	n
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	3	6	13	n	4	27	23	33	24	n	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	7	9	17	2	n	n	9	n	9	n	n	n	n	n	n
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	8	11	11	1	n	1	1	2	1	7	9	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	3	10	4	n	1	4	3	4	23	1	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	11	27	25	n	8	45	41	63	97	42	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	2	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	1	13	19	9	n	2	20	10	20	23	21	n	n	n	n
Georges Bank Crest	n	n	n	n	n	n	n	n	n	n	n	4	4	12	7	22	5	15	5	15	26	1	18	48	6
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	1	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	3	1	7

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

U S G S   D R A F T

Table 4. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	Hypothetical Spill Location T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40	T41
Land	n	6	3	24	2	41	84	5	64	7	40	n	n	1	14	n	n	n	n	n	n	n	n	n	13
Coastal Waterbirds	n	3	2	16	1	19	43	1	29	2	22	n	n	n	11	n	n	n	n	n	n	n	n	n	11
Sea Duck Wint. Areas	10	16	4	22	27	58	59	43	59	42	35	1	n	1	11	n	n	n	n	n	n	n	n	n	12
Osprey Nesting Areas	n	1	1	1	n	12	15	n	16	1	11	n	n	n	3	n	n	n	n	n	n	n	n	n	2
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	1	n	1	1	14	23	2	20	1	10	n	n	n	3	n	n	n	n	n	n	n	n	n	4
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	2	n	n	n	12	2	1	12	2	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	4	3	15	1	29	23	2	32	3	20	n	n	n	11	n	n	n	n	n	n	n	n	n	11
Soft Clam Grounds	n	1	2	2	n	6	14	n	8	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	2	n	2	1	10	5	1	10	2	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	n	n	n	n	1	22	n	6	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	1	n	n	5	70	n	28	n	13	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	2	13	n	1	27	n	11	n	5	n	n	n	8	n	n	n	n	n	n	n	n	n	7
Natl. Parks, Seashr.	n	n	n	5	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	2
State Parks, Seashr.	n	n	n	15	n	2	40	n	17	n	14	n	n	n	2	n	n	n	n	n	n	n	n	n	2
Natl. Wildlife Refs.	n	n	1	3	n	2	11	n	11	n	13	n	n	n	1	n	n	n	n	n	n	n	n	n	1
State Wildlife, Nat.	n	n	n	n	n	1	25	n	9	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	2	14	5	n	6	64	**	12	80	14	41	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	5	n	6	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	1	1	n	n	1	2	n	2	1	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	32	5	n	n	42	8	n	27	2	20	n	7	1	n	n	1	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	1	n	n	n	1	1	n
Gulf Stream Seg. 5	n	n	n	n	n	n	n	n	n	n	n	1	2	n	n	n	14	20	n	n	n	6	6	n	n
Gulf Stream Seg. 6	3	1	n	n	1	n	n	1	n	1	n	7	4	n	n	17	14	13	n	n	35	31	8	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 4. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	Hypothetical Spill Location																								
	T42	T43	T44	T45	T46	T47	T48	T49	T50	T51	T52	T53	T54	T55	T56	T57	T58	T59	T60	T61	T62	T63	T64	T65	T66
Land	n	n	n	n	4	n	n	n	n	13	n	1	1	2	3	2	1	18	19	3	3	27	23	17	57
Coastal Waterbirds	n	n	n	n	1	n	n	n	n	6	n	n	1	1	2	2	n	10	7	3	1	7	10	6	14
Sea Duck Wint. Areas	n	n	n	n	33	n	n	n	n	7	n	n	n	2	2	1	1	19	57	1	2	26	12	n	19
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	n	n	7	3	n	n	3	2	n	4
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	1	n	n	n	1	n	n	2	n	n
Pereg. Falc. Migr.	n	n	n	n	1	n	n	n	n	1	n	n	n	1	1	1	n	3	6	1	n	2	3	4	6
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Grey Seal Rookeries	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	7	4	n	n	n	n	n	n
Hard Clam Grounds	n	n	n	n	2	n	n	n	n	2	n	n	n	1	1	1	1	12	10	1	1	11	3	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	1	n	1	14	n	n	n
Bay Scallop Beds	n	n	n	n	1	n	n	n	n	2	n	n	n	n	n	1	n	5	6	1	1	n	6	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	3	n	n	1
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	35
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	1	n	n	3	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	3	n	n	n	n	1	n	n	n	n	1	1	14	5	n	6
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	1	n	n	n	1	1	n	n	n	n	n	n	1	1	6	3
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	3	n	n	n	n	1	n	n	1	n	1	1	15	7	n	4
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	2	n	n	n	1	1	1	n	1	1	2	1	16	5	5	13
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	1	n	n	n
State Marine Sanct.	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	2	33	37	n	n	2	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	1
Hump. Whale Feeding	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1	4	n	n	n	n	n	n
Georges Bank Crest	n	n	n	n	19	n	n	n	n	n	n	n	n	n	n	n	n	1	15	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	29	n	n	n	n	n	n	n	n	n	n	n	n	13	2
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	36	6	n	n	n	n	n	n	n	n	n	n	n	20	1
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	15	5	1	n	n	n	n	n	n	n	n	n	n	11	n
Gulf Stream Seg. 4	n	n	n	n	n	n	20	1	n	n	10	4	2	n	n	n	n	n	n	n	n	n	n	5	n
Gulf Stream Seg. 5	n	10	16	5	1	n	10	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 6	n	7	26	18	2	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 4. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	Hypothetical Spill Location													
	T67	T68	T69	T70	T71	T72	T73	T74	T75	T76	T77	T78	T79	T80
Land	16	n	n	5	8	n	6	n	14	n	n	21	3	n
Coastal Waterbirds	7	n	n	3	5	n	5	n	11	n	n	7	2	n
Sea Duck Wint. Areas	6	n	n	8	12	n	8	n	3	n	n	11	6	1
Osprey Nesting Areas	4	n	n	2	2	n	1	n	1	n	n	1	1	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	4	n	n	1	n	n
Pereg. Falc. Migr.	3	n	n	2	3	n	2	n	4	n	n	2	n	n
Logg. Turtle Nest.	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	2	n
Hard Clam Grounds	n	n	n	3	5	n	5	n	5	n	n	2	2	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	3	2	n
Oyster Grounds	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	5	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	2	n	n	3	4	n	3	n	2	n	n	3	n	n
Natl. Parks, Seashr.	1	n	n	1	2	n	1	n	1	n	n	5	n	n
State Parks, Seashr.	n	n	n	1	2	n	2	n	1	n	n	3	n	n
Natl. Wildlife Refs.	10	n	n	1	1	n	1	n	9	n	n	2	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	9	n	n	n	n	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	n	7	n
Nongov. Wild., Nat.	4	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	n	n	n	n	n	n	n	n	n	n	n	n	1	9
Gulf Stream Seg. 1	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	1	n	2	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	13	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	2	8	12	1	n	n	n	1	n	n	1	n	n	n
Gulf Stream Seg. 5	n	23	3	n	n	n	n	n	n	n	n	n	2	1
Gulf Stream Seg. 6	n	25	n	n	n	n	n	n	n	n	n	n	2	9

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 5. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location																								
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Land	n	1	1	1	n	2	1	n	n	2	n	1	3	1	n	n	n	1	1	n	n	1	2	1	1
Coastal Waterbirds	n	n	n	n	n	1	n	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	1	1	n
Sea Duck Wint. Areas	n	2	2	2	n	5	3	1	1	5	2	2	7	4	2	1	n	n	n	n	n	n	1	n	n
Osprey Nesting Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	n	1	1	n	n	1	n	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Natl. Wildlife Refs.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	1	2	2	1	n	2	1	1	n	2	1	1	3	2	1	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
Hump. Whale Feeding	n	n	n	n	n	1	1	n	n	1	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n
Georges Bank Crest	4	7	12	10	1	34	27	10	11	**	24	46	99	71	30	12	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	1	n	n	n	2	2	1
Gulf Stream Seg. 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	12	16	15	13	9	10	16	16	15
Gulf Stream Seg. 5	7	5	3	1	1	1	n	n	n	n	n	n	n	n	n	n	10	9	10	12	11	10	10	9	10
Gulf Stream Seg. 6	25	21	20	17	19	17	17	14	11	12	14	8	12	11	10	11	7	8	8	9	12	8	7	6	6

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 5. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location																							
	P26	P27	P28	P29	P30	P31	P32	P33	P34	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
Land	1	2	1	1	2	1	1	1	2	46	33	40	48	40	19	29	64	47	73	56	39	n	1	1	n
Coastal Waterbirds	n	1	n	n	1	n	1	n	1	n	14	18	23	6	n	2	11	4	12	9	9	n	n	n	n
Sea Duck Wint. Areas	1	2	1	n	n	1	n	n	1	n	10	12	15	15	n	6	30	18	32	25	61	n	2	4	2
Osprey Nesting Areas	n	1	n	n	1	n	n	n	n	n	4	2	n	n	n	n	n	n	n	n	2	n	n	n	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	3	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	n	1	n	n	n	n	n	n	1	n	3	7	6	3	n	2	6	5	6	7	13	n	n	n	n
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	1	4	n	n	n	n
Hard Clam Grounds	n	n	n	n	1	n	n	n	1	n	n	1	1	2	n	n	8	2	8	2	7	n	n	n	n
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	3	9	14	4	n	1	12	3	12	1	3	n	n	n	n
Bay Scallop Beds	n	n	n	n	1	n	n	n	n	n	n	n	n	1	n	n	n	1	n	2	6	n	n	n	n
Oyster Grounds	n	n	n	n	n	n	n	n	n	n	n	1	7	2	n	1	2	2	2	7	7	n	n	n	n
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	20	35	48	24	n	7	59	27	65	42	11	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	22	16	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	1	n	n	n	n	n	n	1	n	2	7	8	3	n	1	11	3	13	n	1	n	n	n	n
Natl. Parks, Seashr.	n	1	n	n	n	n	n	n	n	n	1	7	10	16	n	5	29	25	34	25	1	n	n	n	n
State Parks, Seashr.	n	n	n	n	n	n	n	n	n	n	8	10	18	2	n	n	9	n	9	n	n	n	n	n	n
Natl. Wildlife Refs.	n	1	n	n	1	n	n	n	1	n	9	13	12	2	n	1	2	3	1	8	10	n	n	n	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	1	5	12	5	n	2	5	4	4	23	1	n	n	n	n
State Marine Sanct.	n	n	n	n	2	n	n	n	n	n	3	17	36	31	n	11	49	45	64	97	46	n	1	2	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	2	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	1	14	20	10	n	2	20	11	20	24	21	n	n	1	n
Georges Bank Crest	n	n	n	n	n	n	n	n	n	1	6	19	22	30	9	36	17	31	13	28	39	3	24	52	12
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 3	1	1	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 4	15	13	12	9	6	13	11	9	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 5	8	9	11	10	8	11	10	10	7	n	n	n	n	n	n	n	n	n	n	n	2	n	1	n	n
Gulf Stream Seg. 6	7	5	7	8	10	5	7	8	4	n	n	1	2	2	n	2	2	4	2	4	10	3	13	11	14

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

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Table 5. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location																								
	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40	T41
Land	5	25	22	33	9	52	89	15	71	17	56	2	1	2	17	n	n	n	n	n	n	n	n	1	16
Coastal Waterbirds	2	12	13	21	3	24	46	6	32	6	30	1	1	1	13	n	n	n	n	n	n	n	n	1	12
Sea Duck Wint. Areas	13	20	10	25	29	59	59	45	60	44	39	1	1	1	13	n	n	n	n	n	n	n	n	1	13
Osprey Nesting Areas	1	7	7	2	2	15	15	3	18	4	15	n	n	n	4	n	n	n	n	n	n	n	n	n	3
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Migr.	1	3	2	2	2	17	23	4	21	3	13	n	n	1	4	n	n	n	n	n	n	n	n	1	4
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	1	8	4	n	2	14	3	3	13	4	11	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Hard Clam Grounds	2	14	12	20	4	34	25	7	35	8	26	1	1	1	12	n	n	n	n	n	n	n	n	n	11
Soft Clam Grounds	1	4	6	4	1	7	15	2	10	2	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Bay Scallop Beds	1	7	4	3	2	13	6	4	12	4	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Oyster Grounds	n	1	2	n	1	2	22	1	6	1	3	n	n	n	1	n	n	n	n	n	n	n	n	n	1
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	1	4	7	n	1	7	71	1	30	2	17	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	1	5	17	n	2	28	n	12	1	7	n	n	1	9	n	n	n	n	n	n	n	n	n	8
Natl. Parks, Seashr.	n	n	1	6	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	2
State Parks, Seashr.	n	2	5	17	n	3	41	1	18	1	18	n	n	n	2	n	n	n	n	n	n	n	n	n	3
Natl. Wildlife Refs.	1	2	5	6	1	4	12	1	12	1	15	n	n	n	2	n	n	n	n	n	n	n	n	n	2
State Wildlife, Nat.	n	1	3	n	n	2	26	n	10	n	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n
State Marine Sanct.	6	28	19	n	11	68	**	20	82	22	49	2	1	n	n	n	n	n	n	n	n	n	n	n	n
Nongov. Wild., Nat.	n	n	1	n	n	1	5	n	6	n	3	n	n	n	1	n	n	n	n	n	n	n	n	n	1
Humo. Whale Feeding	2	2	n	n	3	3	n	3	1	3	1	n	n	n	n	n	n	n	n	n	n	n	n	n	1
Georges Bank Crest	43	15	1	n	53	16	1	40	5	34	3	15	5	n	n	3	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	1
Gulf Stream Seg. 4	n	n	1	3	n	n	n	n	n	n	n	n	3	11	11	n	n	20	1	1	n	n	3	13	12
Gulf Stream Seg. 5	2	5	6	4	1	4	1	2	2	3	5	1	8	7	6	n	15	20	n	n	n	6	11	10	6
Gulf Stream Seg. 6	17	19	12	2	16	11	4	18	8	17	12	17	21	4	1	19	31	17	1	n	35	36	29	7	1

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 5. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location																								
	T42	T43	T44	T45	T46	T47	T48	T49	T50	T51	T52	T53	T54	T55	T56	T57	T58	T59	T60	T61	T62	T63	T64	T65	T66
Land	n	n	n	n	13	n	n	n	2	19	n	1	2	3	6	4	9	40	33	6	8	41	28	18	61
Coastal Waterbirds	n	n	n	n	5	n	n	n	1	10	n	n	1	2	4	4	5	22	13	5	4	16	13	6	15
Sea Duck Wint. Areas	n	n	n	n	35	n	n	n	1	8	n	n	n	2	3	2	4	24	59	2	3	32	13	n	19
Osprey Nesting Areas	n	n	n	n	3	n	n	n	n	1	n	n	n	1	1	1	4	13	6	n	1	7	3	n	4
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	n	2	n	n	n	n	1	1	n	n	n	1	1	n	3	n	n
Pereg. Falc. Migr.	n	n	n	n	3	n	n	n	1	2	n	n	1	1	2	2	1	6	9	2	1	4	4	4	7
Logg. Turtle Nest.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Grey Seal Rookeries	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	2	12	8	n	n	2	n	n	n
Hard Clam Grounds	n	n	n	n	6	n	n	n	1	4	n	n	n	1	2	1	5	23	15	2	4	19	5	n	n
Soft Clam Grounds	n	n	n	n	1	n	n	n	n	1	n	n	n	n	n	n	1	7	3	n	2	17	1	n	n
Bay Scallop Beds	n	n	n	n	3	n	n	n	n	3	n	n	n	n	n	1	2	10	9	1	2	2	7	n	n
Oyster Grounds	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	2	1	n	n	4	n	n	1
Blue Crab Grounds	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	35
Insh. Lobster Grnds.	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	2	7	4	n	n	6	n	n	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	n	n	n	n	n	n	n	n	1	6	n	n	n	1	2	1	1	2	1	2	3	19	7	n	6
Natl. Parks, Seashr.	n	n	n	n	n	n	n	n	n	1	n	n	n	1	1	1	n	n	n	n	1	2	1	6	5
State Parks, Seashr.	n	n	n	n	1	n	n	n	n	5	n	n	n	n	1	1	2	3	1	1	3	18	8	n	4
Natl. Wildlife Refs.	n	n	n	n	1	n	n	n	1	4	n	n	1	1	2	3	2	4	2	4	2	20	6	5	13
State Wildlife, Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	1	2	1	1	n	2	1	n	n
State Marine Sanct.	n	n	n	1	17	n	n	n	n	n	n	n	n	n	n	n	8	45	44	n	1	10	n	n	n
Nongov. Wild., Nat.	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	1	n	n	n	2	n	n	2
Hump. Whale Feeding	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	2	5	n	n	n	n	n	n
Georges Bank Crest	n	n	n	3	35	n	n	n	n	n	n	n	n	n	n	n	1	6	28	n	n	n	n	n	n
Gulf Stream Seg. 1	n	n	n	n	n	n	n	n	n	n	29	n	n	n	n	n	n	n	n	n	n	n	n	13	4
Gulf Stream Seg. 2	n	n	n	n	n	n	n	n	n	n	36	6	1	n	n	n	n	n	n	n	n	n	n	21	3
Gulf Stream Seg. 3	n	n	n	n	n	n	n	n	n	n	16	7	2	1	1	n	n	n	n	n	n	n	n	14	3
Gulf Stream Seg. 4	n	n	n	n	n	n	21	9	9	7	18	18	16	14	11	10	4	n	n	10	7	1	7	14	5
Gulf Stream Seg. 5	n	10	17	5	3	n	14	11	7	4	9	9	10	8	7	7	7	6	3	6	6	4	3	7	2
Gulf Stream Seg. 6	n	8	32	26	18	n	20	10	5	1	22	17	9	3	2	3	10	17	5	2	4	5	1	13	2

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table 5. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location													
	T67	T68	T69	T70	T71	T72	T73	T74	T75	T76	T77	T78	T79	T80
Land	18	n	n	7	11	1	9	1	16	1	1	25	18	1
Coastal Waterbirds	8	n	n	4	6	1	6	1	13	1	1	10	10	1
Sea Duck Wint. Areas	6	n	n	8	12	1	9	1	4	1	1	12	10	2
Osprey Nesting Areas	4	n	n	2	3	n	2	n	2	n	n	2	5	n
B. Eagle Nest. Areas	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Pereg. Falc. Nest.	n	n	n	n	n	n	n	n	4	n	n	2	n	n
Pereg. Falc. Migr.	3	n	n	2	3	1	2	1	6	n	n	2	2	n
Logg. Turtle Nest.	1	n	n	n	n	n	n	n	n	n	n	n	n	n
Grey Seal Rookeries	n	n	n	n	n	n	n	n	n	n	n	n	6	n
Hard Clam Grounds	n	n	n	3	5	n	6	n	5	n	n	3	10	1
Soft Clam Grounds	n	n	n	n	n	n	n	n	n	n	n	1	3	n
Bay Scallop Beds	n	n	n	n	n	n	n	n	n	n	n	4	6	n
Oyster Grounds	2	n	n	n	1	n	1	n	n	n	n	n	n	n
Blue Crab Grounds	5	n	n	n	n	n	n	n	n	n	n	n	n	n
Insh. Lobster Grnds.	n	n	n	n	n	n	n	n	n	n	n	n	3	n
Harbor Seal Rook.	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Marshes	2	n	n	3	5	n	4	n	3	n	1	5	n	n
Natl. Parks, Seashr.	2	n	n	2	3	1	2	n	1	n	n	5	n	n
State Parks, Seashr.	n	n	n	1	2	n	2	n	1	n	n	5	1	n
Natl. Wildlife Refs.	11	n	n	2	3	1	1	n	10	n	n	4	1	n
State Wildlife, Nat.	n	n	n	n	n	n	n	n	9	n	n	n	1	n
State Marine Sanct.	n	n	n	n	n	n	n	n	n	n	n	n	22	1
Nongov. Wild., Nat.	4	n	n	1	1	n	1	n	1	n	n	n	n	n
Hump. Whale Feeding	n	n	n	n	n	n	n	n	n	n	n	n	1	1
Georges Bank Crest	n	n	n	n	n	n	n	n	n	n	n	n	8	16
Gulf Stream Seg. 1	2	n	n	n	n	n	n	n	n	n	n	n	n	n
Gulf Stream Seg. 2	3	n	2	n	1	n	1	n	n	n	n	n	n	n
Gulf Stream Seg. 3	3	n	13	2	2	1	1	1	1	1	n	n	n	n
Gulf Stream Seg. 4	14	9	14	17	14	15	13	15	11	13	11	7	n	n
Gulf Stream Seg. 5	8	24	7	8	7	9	7	8	6	9	9	4	6	1
Gulf Stream Seg. 6	8	36	12	6	3	5	4	6	2	6	5	1	22	18

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

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Table 7. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 10 days.

Land Segment	Hypothetical Spill Location																							
	P26	P27	P28	P29	P30	P31	P32	P33	P34	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	2	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	1	n	4	18	n	n	n	n
26	n	n	n	n	n	n	n	n	n	n	n	n	1	3	n	2	4	4	4	18	9	n	n	n	n
27	n	n	n	n	n	n	n	n	n	n	n	3	5	12	n	4	25	22	31	21	n	n	n	n	n
28	n	n	n	n	n	n	n	n	n	n	n	1	2	4	n	1	10	4	13	n	n	n	n	n	n
29	n	n	n	n	n	n	n	n	n	n	n	1	3	3	n	n	11	1	13	n	n	n	n	n	n
30	n	n	n	n	n	n	n	n	n	n	n	4	12	1	n	n	n	n	n	n	n	n	n	n	n
31	n	n	n	n	n	n	n	n	n	n	n	1	8	n	n	n	n	n	n	n	n	n	n	n	n
32	n	n	n	n	n	n	n	n	n	n	2	6	1	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	9	7	n	n	n	n	n	n	n	n	n	n	n	n	n
34	n	n	n	n	n	n	n	n	n	n	6	2	n	n	n	n	n	n	n	n	n	n	n	n	n
35	n	n	n	n	n	n	n	n	n	39	2	n	n	n	8	2	n	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table 7. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 10 days.

Land Segment	Hypothetical Spill Location																								
	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40	T41
7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	2
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	3
9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	1
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	n	n	n	n	n	n	n	n	n	7
12	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	n	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	n	n	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	n	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	n	n	1	2	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	n	n	n	n	1	n	1	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	n	n	n	n	3	n	2	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
20	n	n	n	n	n	1	9	n	8	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21	n	n	n	n	n	n	2	n	1	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	n	n	n	n	n	n	24	n	5	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	n	n	n	n	n	2	23	n	8	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	n	2	1	n	n	19	21	n	23	1	12	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	n	4	n	n	2	18	1	5	19	6	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n
26	n	n	n	n	n	1	n	n	1	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table 7. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 10 days.

Land Segment	T42	T43	T44	T45	T46	T47	T48	T49	T50	T51	T52	T53	T54	T55	T56	T57	T58	T59	T60	T61	T62	T63	T64	T65	T66
	Hypothetical Spill Location																								
2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	3
3	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	11	20
4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	16
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	18
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
7	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n
11	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	1	n	n	n	1	n	n	1	n	n
12	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	1	n	n	n	2	1	n	7	n	n
13	n	n	n	n	n	n	n	n	n	7	n	n	n	n	n	n	n	n	n	n	1	n	13	n	n
15	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n
17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	17	n	n	n
18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n
19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	3	n	n	n	n	n	n
25	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	9	15	n	n	n	n	n	n
26	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

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Table 7. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 10 days.

Land Segment	Hypothetical Spill Location													
	T67	T68	T69	T70	T71	T72	T73	T74	T75	T76	T77	T78	T79	T80
2	1	n	n	n	n	n	n	n	n	n	n	n	n	n
3	6	n	n	n	n	n	n	n	n	n	n	n	n	n
4	2	n	n	n	n	n	n	n	n	n	n	n	n	n
5	4	n	n	n	n	n	n	n	n	n	n	n	n	n
6	3	n	n	n	n	n	n	n	n	n	n	n	n	n
7	n	n	n	2	3	n	1	n	1	n	n	n	n	n
8	n	n	n	2	3	n	2	n	1	n	n	n	n	n
9	n	n	n	n	n	n	1	n	n	n	n	n	n	n
10	n	n	n	n	2	n	2	n	4	n	n	n	n	n
11	n	n	n	n	n	n	n	n	7	n	n	1	n	n
12	n	n	n	n	n	n	n	n	n	n	n	3	n	n
13	n	n	n	n	n	n	n	n	n	n	n	11	n	n
14	n	n	n	n	n	n	n	n	n	n	n	5	n	n
15	n	n	n	n	n	n	n	n	n	n	n	1	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	1	n
25	n	n	n	n	n	n	n	n	n	n	n	n	2	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

U S G S   D R A F T

Table 8. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location																								
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	1	n
24	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	n	1	n	n	n	1	1	n	n	1	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

U S G S   D R A F T

Table 8. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location P26	P27	P28	P29	P30	P31	P32	P33	P34	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
7	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	3	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	1	1	2	n	1	1	2	1	6	20	n	n	1	n
26	n	n	n	n	n	n	n	n	n	n	n	2	2	4	n	2	5	5	5	19	10	n	n	n	n
27	n	n	n	n	n	n	n	n	n	n	1	6	9	15	n	5	28	23	32	22	n	n	n	n	n
28	n	n	n	n	n	n	n	n	n	n	n	2	3	4	n	1	10	4	13	n	n	n	n	n	n
29	n	n	n	n	n	n	n	n	n	n	n	2	4	3	n	n	11	1	13	n	n	n	n	n	n
30	n	n	n	n	n	n	n	n	n	n	n	4	13	1	n	n	n	n	n	n	n	n	n	n	n
31	n	n	n	n	n	n	n	n	n	n	n	2	8	n	n	n	n	n	n	n	n	n	n	n	n
32	n	n	n	n	n	n	n	n	n	n	2	6	1	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	9	8	n	n	n	n	n	n	n	n	n	n	n	n	n
34	n	n	n	n	n	n	n	n	n	n	8	3	n	n	n	n	n	n	n	n	n	n	n	n	n
35	n	n	n	n	n	n	n	n	n	45	12	6	6	10	18	19	8	11	7	9	3	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

U S G S   D R A F T

Table 8. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location																							
	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	T35	T36	T37	T38	T39	T40	T41
3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	1
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	1
7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	2
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	4
9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	1
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	n	n	n	n	n	n	n	n	n	7
11	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	n	n	n	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	n	n	3	5	n	1	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	n	n	n	n	2	n	1	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	1	n	n	n	3	n	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
20	n	n	1	n	n	1	9	n	9	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21	n	1	1	n	n	n	2	n	2	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	n	1	2	n	n	1	24	n	5	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	n	1	2	n	n	2	23	n	8	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	1	8	6	n	2	22	21	3	25	4	16	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	3	12	5	n	5	22	3	10	18	10	14	1	1	n	n	n	n	n	n	n	n	n	n	n	n
26	n	1	n	n	n	2	n	n	1	1	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n
35	1	n	n	n	1	1	n	1	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table 8. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location																							
	T42	T43	T44	T45	T46	T47	T48	T49	T50	T51	T52	T53	T54	T55	T56	T57	T58	T59	T60	T61	T62	T63	T64	T65	T66
2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	4
3	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n	11	23
4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	16
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	18
6	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	1
7	n	n	n	n	n	n	n	n	n	n	n	n	n	1	2	1	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n
10	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	1	n	n	n	1	n	n	1	n	n
11	n	n	n	n	n	n	n	n	n	1	n	n	n	n	1	1	n	n	n	1	1	n	2	n	n
12	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	1	n	n	n	2	2	n	8	n	n
13	n	n	n	n	n	n	n	n	n	9	n	n	n	n	n	n	n	n	n	n	1	n	13	n	n
15	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
16	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n
17	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	2	21	1	n	n
18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n
19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n
20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	1	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	4	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	1	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	2	1	n	n	2	n	n	n
24	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	3	14	7	n	n	4	n	n	n
25	n	n	n	n	7	n	n	n	n	n	n	n	n	n	n	n	2	17	21	n	n	2	n	n	n
26	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1	2	n	n	n	n	n	n
35	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

U S G S   D R A F T

Table 8. (Continued) -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location													
	T67	T68	T69	T70	T71	T72	T73	T74	T75	T76	T77	T78	T79	T80
2	2	n	n	n	n	n	n	n	n	n	n	n	n	n
3	7	n	n	1	1	n	1	n	1	n	n	n	n	n
4	2	n	n	n	n	n	n	n	n	n	n	n	n	n
5	4	n	n	n	n	n	n	n	n	n	n	n	n	n
6	3	n	n	1	1	n	1	n	n	n	n	n	n	n
7	n	n	n	2	3	n	2	n	1	n	n	n	n	n
8	n	n	n	2	3	n	2	n	2	n	n	n	n	n
9	n	n	n	n	n	n	1	n	n	n	n	n	n	n
10	n	n	n	n	2	n	2	n	4	n	n	1	n	n
11	n	n	n	n	n	n	n	n	7	n	n	1	n	n
12	n	n	n	n	n	n	n	n	n	n	n	4	n	n
13	n	n	n	n	n	n	n	n	n	n	n	11	n	n
14	n	n	n	n	n	n	n	n	n	n	n	5	n	n
15	n	n	n	n	n	n	n	n	n	n	n	1	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	1	n
24	n	n	n	n	n	n	n	n	n	n	n	n	5	n
25	n	n	n	n	n	n	n	n	n	n	n	n	10	1
26	n	n	n	n	n	n	n	n	n	n	n	n	1	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table 9. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the expected production life of the lease area, proposed vs. proposed and Sale 42 leases.

Target	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Sale 42 and Proposed			Proposed			Sale 42 and Proposed			Proposed			Sale 42 and Proposed		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
Land	15	0	0.2	16	0	0.2	39	0	0.5	42	0	0.5	71	1	1.3	75	1	1.4
Coastal Waterbirds	13	0	0.1	14	0	0.1	27	0	0.3	29	0	0.3	51	0	0.7	54	0	0.8
Sea Duck Wint. Areas	37	0	0.5	40	0	0.5	53	0	0.7	57	0	0.8	64	1	1.0	68	1	1.1
Osprey Nesting Areas	1	0	0.0	1	0	0.0	5	0	0.1	6	0	0.1	24	0	0.3	26	0	0.3
B. Eagle Nest. Areas	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Pereg. Falc. Nest	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
Pereg. Falc. Migr	n	0	0.0	n	0	0.0	3	0	0.0	4	0	0.0	11	0	0.1	13	0	0.1
Logg. Turtle Nest	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Grey Seal Rookeries	n	0	0.0	n	0	0.0	4	0	0.0	4	0	0.0	18	0	0.2	19	0	0.2
Hard Clam Grounds	11	0	0.1	12	0	0.1	28	0	0.3	30	0	0.4	51	0	0.7	55	0	0.8
Soft Clam Grounds	n	0	0.0	n	0	0.0	7	0	0.1	7	0	0.1	19	0	0.2	21	0	0.2
Bay Scallop Beds	n	0	0.0	n	0	0.0	6	0	0.1	7	0	0.1	21	0	0.2	23	0	0.3
Oyster Grounds	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	4	0	0.0	5	0	0.0
Blue Crab Grounds	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Insh. Lobster Grnds.	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	16	0	0.2	17	0	0.2
Harbor Seal Rook.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Coastal Marshes	9	0	0.1	10	0	0.1	20	0	0.2	22	0	0.3	30	0	0.4	32	0	0.4
Natl. Parks, Seashr.	3	0	0.0	3	0	0.0	7	0	0.1	8	0	0.1	9	0	0.1	10	0	0.1
State Parks, Seashr.	11	0	0.1	13	0	0.1	20	0	0.2	2	0	0.2	29	0	0.3	32	0	0.4
Natl. Wildlife Refs.	1	0	0.0	1	0	0.0	6	0	0.1	6	0	0.1	18	0	0.2	19	0	0.2
State Wildlife, Nat.	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	6	0	0.1	7	0	0.1
State Marine Sanct.	n	0	0.0	n	0	0.0	26	0	0.3	28	0	0.3	56	0	0.8	60	0	0.9
Nongov. Wild., Ha.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
Hump. Whale Feeding	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	7	0	0.1	8	0	0.1
Georges Bank Crest	32	0	0.4	42	0	0.5	57	0	0.8	66	1	1.1	75	1	1.4	82	1	1.7
Gulf Stream Seg. 1	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 3	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 4	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	9	0	0.1	10	0	0.1
Gulf Stream Seg. 5	n	0	0.0	n	0	0.0	7	0	0.1	7	0	0.1	30	0	0.4	32	0	0.4
Gulf Stream Seg. 6	n	0	0.0	n	0	0.0	30	0	0.4	31	0	0.4	77	1	1.5	80	1	1.6

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table 10. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, proposed vs. proposed and Sale 42 leases.

Land Segment	within 3 days						Within 10 days						Within 30 days					
	Proposed			Sale 42 and Proposed			Proposed			Sale 42 and Proposed			Proposed			Sale 42 and Proposed		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
9	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
10	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0	2	0	0.0
11	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
12	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
13	4	0	0.0	4	0	0.0	8	0	0.1	9	0	0.1	10	0	0.1	11	0	0.1
14	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0
15	8	0	0.1	9	0	0.1	13	0	0.1	14	0	0.2	14	0	0.1	15	0	0.2
16	2	0	0.0	3	0	0.0	6	0	0.1	7	0	0.1	8	0	0.1	9	0	0.1
17	n	0	0.0	n	0	0.0	5	0	0.0	5	0	0.1	11	0	0.1	12	0	0.1
19	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
20	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
21	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
22	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	4	0	0.0
23	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	4	0	0.0	5	0	0.1
24	n	0	0.0	n	0	0.0	4	0	0.0	4	0	0.0	20	0	0.2	22	0	0.3
25	n	0	0.0	n	0	0.0	7	0	0.1	7	0	0.1	25	0	0.3	28	0	0.3
26	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	4	0	0.0
35	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than a 0.5 percent probability of one or more contacts within 30 days are not shown

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Table 11. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the expected production life of the lease area, low vs. high volume estimates.

Target	Within 3 days Low Prob	Within 3 days Low Mode	Within 3 days Low Mean	Within 3 days High Prob	Within 3 days High Mode	Within 3 days High Mean	Within 10 days Low Prob	Within 10 days Low Mode	Within 10 days Low Mean	Within 10 days High Prob	Within 10 days High Mode	Within 10 days High Mean	Within 30 days Low Prob	Within 30 days Low Mode	Within 30 days Low Mean	Within 30 days High Prob	Within 30 days High Mode	Within 30 days High Mean
Land	n	0	0.0	20	0	0.2	1	0	0.0	47	0	0.6	1	0	0.0	81	1	1.7
Coastal Waterbirds	n	0	0.0	17	0	0.2	n	0	0.0	34	0	0.4	1	0	0.0	61	0	0.9
Sea Duck Wint. Areas	n	0	0.0	45	0	0.6	1	0	0.0	64	1	1.0	1	0	0.0	77	1	1.5
Osprey Nesting Areas	n	0	0.0	1	0	0.0	n	0	0.0	7	0	0.1	n	0	0.0	30	0	0.4
B. Eagle Nest. Areas	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Pereg. Falc. Nest.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0
Pereg. Falc. Migr.	n	0	0.0	1	0	0.0	n	0	0.0	5	0	0.1	n	0	0.0	16	0	0.2
Logg. Turtle Nest.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Grey Seal Rookeries	n	0	0.0	n	0	0.0	n	0	0.0	5	0	0.1	n	0	0.0	23	0	0.3
Hard Clam Grounds	n	0	0.0	16	0	0.2	n	0	0.0	35	0	0.4	1	0	0.0	62	0	1.0
Soft Clam Grounds	n	0	0.0	n	0	0.0	n	0	0.0	8	0	0.1	n	0	0.0	24	0	0.3
Bay Scallop Beds	n	0	0.0	n	0	0.0	n	0	0.0	7	0	0.1	n	0	0.0	27	0	0.3
Oyster Grounds	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	6	0	0.1
Blue Crab Grounds	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Insh. Lobster Grnds.	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	20	0	0.2
Harbor Seal Rook.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Coastal Marshes	n	0	0.0	12	0	0.1	n	0	0.0	26	0	0.3	n	0	0.0	37	0	0.5
Natl. Parks, Seashr.	n	0	0.0	4	0	0.0	n	0	0.0	9	0	0.1	n	0	0.0	12	0	0.1
State Parks, Seashr.	n	0	0.0	14	0	0.2	n	0	0.0	24	0	0.3	n	0	0.0	35	0	0.4
Natl. Wildlife Refs.	n	0	0.0	1	0	0.0	n	0	0.0	7	0	0.1	n	0	0.0	22	0	0.3
State Wildlife, Nat.	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	8	0	0.1
State Marine Sanct.	n	0	0.0	n	0	0.0	n	0	0.0	31	0	0.4	1	0	0.0	68	1	1.1
Nongov. Wild., Nat.	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0
Hump. Whale Feeding	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	12	0	0.1
Georges Bank Crest	n	0	0.0	64	1	1.0	1	0	0.0	88	2	2.1	1	0	0.0	97	3	3.6
Gulf Stream Seg. 1	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 3	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0
Gulf Stream Seg. 4	n	0	0.0	23	0	0.3	n	0	0.0	24	0	0.3	n	0	0.0	38	0	0.5
Gulf Stream Seg. 5	n	0	0.0	22	0	0.2	n	0	0.0	47	0	0.6	n	0	0.0	68	1	1.1
Gulf Stream Seg. 6	n	0	0.0	1	0	0.0	n	0	0.0	82	1	1.7	1	0	0.0	99	4	4.5

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table 12. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, low vs. high volume estimates.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Low			High			Low			High			Low			High		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
7	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0
8	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0
10	n	0	0.0	3	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	4	0	0.0
11	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
12	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	5	0	0.1
13	n	0	0.0	4	0	0.0	n	0	0.0	10	0	0.1	n	0	0.0	13	0	0.1
14	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0
15	n	0	0.0	10	0	0.1	n	0	0.0	15	0	0.2	n	0	0.0	17	0	0.2
16	n	0	0.0	3	0	0.0	n	0	0.0	7	0	0.1	n	0	0.0	10	0	0.1
17	n	0	0.0	n	0	0.0	n	0	0.0	6	0	0.1	n	0	0.0	13	0	0.1
18	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
19	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
20	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0
21	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0
22	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	4	0	0.0
23	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	6	0	0.1
24	n	0	0.0	n	0	0.0	n	0	0.0	5	0	0.0	n	0	0.0	26	0	0.3
25	n	0	0.0	n	0	0.0	n	0	0.0	8	0	0.1	n	0	0.0	34	0	0.4
26	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	5	0	0.0
35	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than a 0.5 percent probability of one or more contacts within 30 days are not shown.

Table 13. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the expected production life of the lease area, 0-2,000 m vs. +200 m volume estimates.

Target	Within 3 days						Within 10 days						Within 30 days					
	0-2,000 m			+200 m			0-2,000 m			+200 m			0-2,000 m			+200 m		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
Land	14	0	0.2	13	0	0.1	39	0	0.5	35	0	0.4	71	1	1.3	67	1	1.1
Coastal Waterbirds	12	0	0.1	11	0	0.1	27	0	0.3	24	0	0.3	50	0	0.7	47	0	0.6
Sea Duck Wint. Areas	37	0	0.5	33	0	0.4	53	0	0.7	48	0	0.6	63	1	1.0	58	0	0.9
Osprey Nesting Areas	1	0	0.0	1	0	0.0	5	0	0.1	5	0	0.0	24	0	0.3	22	0	0.2
B. Eagle Nest. Areas	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Pereg. Falc. Nest.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
Pereg. Falc. Migr.	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0	11	0	0.1	10	0	0.1
Logg. Turtle Nest.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Grey Seal Rookeries	n	0	0.0	n	0	0.0	4	0	0.0	4	0	0.0	18	0	0.2	16	0	0.2
Hard Clam Grounds	11	0	0.1	10	0	0.1	28	0	0.3	25	0	0.3	51	0	0.7	47	0	0.6
Soft Clam Grounds	n	0	0.0	n	0	0.0	7	0	0.1	6	0	0.1	19	0	0.2	18	0	0.2
Bay Scallop Beds	n	0	0.0	n	0	0.0	6	0	0.1	6	0	0.1	21	0	0.2	19	0	0.2
Oyster Grounds	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	4	0	0.0	4	0	0.0
Blue Crab Grounds	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Insh. Lobster Grnds.	n	0	0.0	n	0	0.0	2	0	0.0	1	0	0.0	16	0	0.2	14	0	0.2
Harbor Seal Rook.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Coastal Marshes	9	0	0.1	8	0	0.1	20	0	0.2	18	0	0.2	30	0	0.3	27	0	0.3
Natl. Parks, Seashr.	3	0	0.0	3	0	0.0	8	0	0.1	7	0	0.1	9	0	0.1	8	0	0.1
State Parks, Seashr.	12	0	0.1	10	0	0.1	20	0	0.2	18	0	0.2	30	0	0.4	27	0	0.3
Natl. Wildlife Refs.	1	0	0.0	n	0	0.0	6	0	0.1	5	0	0.1	18	0	0.2	16	0	0.2
State Wildlife, Nat.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	6	0	0.1	6	0	0.1
State Marine Sanct.	n	0	0.0	n	0	0.0	26	0	0.3	24	0	0.3	56	0	0.8	52	0	0.7
Nongov. Wild., Nat.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
Hump. Whale Feeding	n	0	0.0	n	0	0.0	2	0	0.0	1	0	0.0	7	0	0.1	6	0	0.1
Georges Bank Crest	31	0	0.4	12	0	0.1	56	0	0.8	35	0	0.4	74	1	1.3	59	0	0.9
Gulf Stream Seg. 1	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 3	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 4	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	6	0	0.1	6	0	0.1
Gulf Stream Seg. 5	n	0	0.0	n	0	0.0	6	0	0.1	7	0	0.1	28	0	0.3	26	0	0.3
Gulf Stream Seg. 6	n	0	0.0	n	0	0.0	26	0	0.3	29	0	0.3	74	1	1.3	71	1	1.2

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

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Table 14. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, 0-2,000 m vs. +200 m volume estimates.

Land Segment	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	0-2,000 m			+200 m			0-2,000 m			+200 m			0-2,000 m			+200 m		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
10	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
11	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
12	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
13	4	0	0.0	3	0	0.0	8	0	0.1	8	0	0.1	11	0	0.1	9	0	0.1
14	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0
15	8	0	0.1	8	0	0.1	13	0	0.1	12	0	0.1	14	0	0.2	13	0	0.1
16	2	0	0.0	2	0	0.0	6	0	0.1	5	0	0.1	8	0	0.1	7	0	0.1
17	n	0	0.0	n	0	0.0	5	0	0.1	4	0	0.0	11	0	0.1	10	0	0.1
19	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
20	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	2	0	0.0
21	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
22	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
23	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	5	0	0.0	4	0	0.0
24	n	0	0.0	n	0	0.0	4	0	0.0	4	0	0.0	21	0	0.2	19	0	0.2
25	n	0	0.0	n	0	0.0	7	0	0.1	6	0	0.1	25	0	0.3	23	0	0.3
26	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
35	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	1	0	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than a 0.5 percent probability of one or more contacts within 30 days are not shown

Table 15. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the expected production life of the lease area, Sale 42 vs. Sales 40, 49, and 59.

Target	Within 3 days: Sale 42			Within 3 days: Sales 40, 49, 59			Within 10 days: Sale 42			Within 10 days: Sales 40, 49, 59			Within 30 days: Sale 42			Within 30 days: Sales 40 49, 59		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
Land	2	0	0.0	31	0	0.4	5	0	0.1	42	0	0.5	13	0	0.1	50	0	0.7
Coastal Waterbirds	1	0	0.0	28	0	0.3	3	0	0.0	34	0	0.4	7	0	0.1	40	0	0.5
Sea Duck Wint. Areas	5	0	0.1	2	0	0.0	8	0	0.1	11	0	0.1	11	0	0.1	17	0	0.2
Osprey Nesting Areas	n	0	0.0	2	0	0.0	1	0	0.0	6	0	0.1	3	0	0.0	9	0	0.1
B. Eagle Nest. Areas	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Pereg. Falc. Nest.	n	0	0.0	13	0	0.1	n	0	0.0	14	0	0.1	n	0	0.0	14	0	0.2
Pereg. Falc. Migr.	n	0	0.0	12	0	0.1	n	0	0.0	16	0	0.2	1	0	0.0	21	0	0.2
Logg. Turtle Nest.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
Grey Seal Rookeries	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
Hard Clam Grounds	1	0	0.0	9	0	0.1	3	0	0.0	17	0	0.2	7	0	0.1	19	0	0.2
Soft Clam Grounds	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
Bay Scallop Beds	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
Oyster Grounds	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0
Blue Crab Grounds	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Insh. Lobster Grnds.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
Harbor Seal Rook.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Coastal Marshes	1	0	0.0	5	0	0.0	2	0	0.0	9	0	0.1	4	0	0.0	13	0	0.1
Natl. Parks, Seashr.	n	0	0.0	n	0	0.0	1	0	0.0	3	0	0.0	1	0	0.0	7	0	0.1
State Parks, Seashr.	1	0	0.0	1	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0	6	0	0.1
Natl. Wildlife Refs.	n	0	0.0	28	0	0.3	1	0	0.0	30	0	0.4	2	0	0.0	33	0	0.4
State Wildlife, Nat.	n	0	0.0	28	0	0.3	n	0	0.0	30	0	0.4	1	0	0.0	30	0	0.4
State Marine Sanct.	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	9	0	0.1	n	0	0.0
Nongov. Wild., Nat.	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	4	0	0.0
Hump. Whale Feeding	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0
Georges Bank Crest	16	0	0.2	n	0	0.0	22	0	0.2	n	0	0.0	26	0	0.3	n	0	0.0
Gulf Stream Seg. 1	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0
Gulf Stream Seg. 2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
Gulf Stream Seg. 3	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	9	0	0.1
Gulf Stream Seg. 4	n	0	0.0	n	0	0.0	n	0	0.0	9	0	0.1	1	0	0.0	81	1	1.7
Gulf Stream Seg. 5	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0	70	1	1.2
Gulf Stream Seg. 6	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	13	0	0.1	57	0	0.9

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

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Table 16. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, Sale 42 vs. Sales 40, 49, and 59 leases.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Sale 42			Sales 40, 49, 59			Sale 42			Sales 40, 49, 59			Sale 42			Sales 40, 49, 59		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
3	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0
7	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	6	0	0.1
[illegible]	n	0	0.0	1	0	0.0	n	0	0.0	5	0	0.1	n	0	0.0	7	0	0.1
9	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0
10	n	0	0.0	9	0	0.1	n	0	0.0	15	0	0.2	n	0	0.0	15	0	0.2
11	n	0	0.0	23	0	0.3	n	0	0.0	24	0	0.3	n	0	0.0	25	0	0.3
13	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0
15	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
16	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0
17	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0
24	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0
25	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0

Notes: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than a 0.5 percent probability of one or more contacts within 30 days are not shown

Table B-1. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the expected production life of the lease area, proposed vs. existing transportation of oil.

Target	Within 3 days: Proposed Prob	Mode	Mean	Within 3 days: Existing Transportation Prob	Mode	Mean	Within 10 days: Proposed Prob	Mode	Mean	Within 10 days: Existing Transportation Prob	Mode	Mean	Within 30 days: Proposed Prob	Mode	Mean	Within 30 days: Existing Transportation Prob	Mode	Mean
Land	15	0	0.2	92	2	2.5	39	0	0.5	**	5	5.4	71	1	1.3	**	8	8.0
Coastal Waterbirds	13	0	0.1	65	1	1.0	27	0	0.3	89	2	2.2	51	0	0.7	96	3	3.2
Sea Duck Wint. Areas	37	0	0.5	98	4	4.0	53	0	0.7	99	5	5.2	64	1	1.0	**	5	5.7
Osprey Nesting Areas	1	0	0.0	21	0	0.2	5	0	0.1	53	0	0.7	24	0	0.3	71	1	1.2
B. Eagle Nest. Areas	n	0	0.0	6	0	0.1	n	0	0.0	10	0	0.1	n	0	0.0	12	0	0.1
Pereg. Falc. Nest.	n	0	0.0	2	0	0.0	n	0	0.0	7	0	0.1	2	0	0.0	10	0	0.1
Pereg. Falc. Migr.	n	0	0.0	38	0	0.5	3	0	0.0	65	1	1.1	11	0	0.1	77	1	1.5
Logg. Turtle Nest.	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	3	0	0.0
Grey Seal Rookeries	n	0	0.0	6	0	0.1	4	0	0.0	26	0	0.3	18	0	0.2	42	0	0.6
Hard Clam Grounds	11	0	0.1	51	0	0.7	28	0	0.3	79	1	1.5	51	0	0.7	89	2	2.2
Soft Clam Grounds	n	0	0.0	16	0	0.2	7	0	0.1	34	0	0.4	19	0	0.2	48	0	0.6
Bay Scallop Beds	n	0	0.0	13	0	0.1	6	0	0.1	37	0	0.5	21	0	0.2	53	0	0.8
Oyster Grounds	n	0	0.0	12	0	0.1	1	0	0.0	25	0	0.3	4	0	0.0	34	0	0.4
Blue Crab Grounds	n	0	0.0	3	0	0.0	n	0	0.0	5	0	0.0	n	0	0.0	5	0	0.1
Insh. Lobster Grnds.	n	0	0.0	72	1	1.3	2	0	0.0	83	1	1.8	16	0	0.2	88	2	2.1
Harbor Seal Rook.	n	0	0.0	29	0	0.3	n	0	0.0	35	0	0.4	n	0	0.0	37	0	0.5
Coastal Marshes	9	0	0.1	48	0	0.6	20	0	0.2	64	1	1.0	30	0	0.4	74	1	1.4
Natl. Parks, Seashr.	3	0	0.0	34	0	0.4	7	0	0.1	57	0	0.8	9	0	0.1	66	1	1.1
State Parks, Seashr.	11	0	0.1	47	0	0.6	20	0	0.2	65	1	1.0	29	0	0.3	73	1	1.3
Natl. Wildlife Refs.	1	0	0.0	38	0	0.5	6	0	0.1	66	1	1.1	18	0	0.2	78	1	1.5
State Wildlife, Nat.	n	0	0.0	22	0	0.2	n	0	0.0	32	0	0.4	6	0	0.1	40	0	0.5
State Marine Sanct.	n	0	0.0	89	2	2.2	26	0	0.3	97	3	3.5	56	0	0.8	99	4	4.4
Nongov. Wild., Nat.	n	0	0.0	7	0	0.1	n	0	0.0	19	0	0.2	3	0	0.0	31	0	0.4
Hump. Whale Feeding	n	0	0.0	44	0	0.6	2	0	0.0	50	0	0.7	7	0	0.1	56	0	0.8
Georges Bank Crest	32	0	0.4	42	0	0.5	57	0	0.8	88	2	2.1	75	1	1.4	97	3	3.6
Gulf Stream Seg. 1	n	0	0.0	90	2	2.3	n	0	0.0	91	2	2.4	n	0	0.0	91	2	2.4
Gulf Stream Seg. 2	n	0	0.0	94	2	2.8	n	0	0.0	97	3	3.6	n	0	0.0	98	3	3.8
Gulf Stream Seg. 3	n	0	0.0	61	0	0.9	n	0	0.0	95	2	3.0	n	0	0.0	97	3	3.6
Gulf Stream Seg. 4	n	0	0.0	34	0	0.4	n	0	0.0	96	3	3.2	9	0	0.1	**	9	9.6
Gulf Stream Seg. 5	n	0	0.0	21	0	0.2	7	0	0.1	68	1	1.1	30	0	0.4	**	6	6.1
Gulf Stream Seg. 6	n	0	0.0	35	0	0.4	30	0	0.4	81	1	1.7	77	1	1.5	**	10	10.5

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table B-2. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, proposed vs. existing transportation of oil.

Land Segment	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	Proposed			Existing Transportation			Proposed			Existing Transportation			Proposed			Existing Transportation		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	11	0	0.1
3	n	0	0.0	3	0	0.0	n	0	0.0	15	0	0.2	n	0	0.0	33	0	0.4
4	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	6	0	0.1
5	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	2	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	6	0	0.1	n	0	0.0	16	0	0.2
7	n	0	0.0	3	0	0.0	n	0	0.0	26	0	0.3	n	0	0.0	31	0	0.4
8	n	0	0.0	19	0	0.2	n	0	0.0	29	0	0.3	1	0	0.0	31	0	0.4
9	n	0	0.0	3	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	4	0	0.0
10	1	0	0.0	11	0	0.1	1	0	0.0	13	0	0.1	2	0	0.0	15	0	0.2
11	n	0	0.0	1	0	0.0	n	0	0.0	4	0	0.0	1	0	0.0	7	0	0.1
12	n	0	0.0	7	0	0.1	2	0	0.0	17	0	0.2	4	0	0.0	21	0	0.2
13	4	0	0.0	22	0	0.2	8	0	0.1	30	0	0.4	10	0	0.1	33	0	0.4
14	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0
15	8	0	0.1	5	0	0.0	13	0	0.1	9	0	0.1	14	0	0.1	10	0	0.1
16	2	0	0.0	1	0	0.0	6	0	0.1	3	0	0.0	8	0	0.1	5	0	0.1
17	n	0	0.0	2	0	0.0	5	0	0.0	7	0	0.[illegible]	11	0	0.1	14	0	0.2
18	n	0	0.0	3	0	0.0	n	0	0.0	4	0	0.0	n	0	0.0	5	0	0.0
19	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	1	0	0.0	6	0	0.1
20	n	0	0.0	5	0	0.0	n	0	0.0	8	0	0.1	3	0	0.0	13	0	0.1
21	n	0	0.0	4	0	0.0	n	0	0.0	7	0	0.1	2	0	0.0	10	0	0.1
22	n	0	0.0	2	0	0.0	n	0	0.0	6	0	0.1	3	0	0.0	10	0	0.1
23	n	0	0.0	5	0	0.0	n	0	0.0	10	0	0.1	4	0	0.0	16	0	0.2
24	n	0	0.0	11	0	0.1	4	0	0.0	33	0	0.4	20	0	0.2	52	0	0.7
25	n	0	0.0	17	0	0.2	7	0	0.1	47	0	0.6	25	0	0.3	66	1	1.1
26	n	0	0.0	16	0	0.2	n	0	0.0	25	0	0.3	3	0	0.0	31	0	0.4
27	n	0	0.0	26	0	0.3	n	0	0.0	36	0	0.5	n	0	0.0	40	0	0.5
28	n	0	0.0	7	0	0.1	n	0	0.0	10	0	0.1	n	0	0.0	12	0	0.1
29	n	0	0.0	9	0	0.1	n	0	0.0	10	0	0.1	n	0	0.0	11	0	0.1
30	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	4	0	0.0
31	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	2	0	0.0
32	n	0	0.0	3	0	0.0	n	0	0.0	5	0	0.1	n	0	0.0	5	0	0.1
33	n	0	0.0	14	0	0.2	n	0	0.0	17	0	0.2	n	0	0.0	17	0	0.2
34	n	0	0.0	6	0	0.1	n	0	0.0	11	0	0.1	n	0	0.0	13	0	0.1
35	n	0	0.0	19	0	0.2	n	0	0.0	48	0	0.6	2	0	0.0	72	1	1.3

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than a 0.5 percent probability of one or more contacts within 30 days are not shown

APPENDIX E

USGS ANALYSIS OF NORTH ATLANTIC OCS OPERATING ORDERS

Appendix E. USGS Analysis of North Atlantic OCS Operating Orders

Order No. 1

This Order specifies the type of identifying signs to be placed on both fixed and nonfixed structures on the OCS. Each well completed must also have an identifying sign. If any subsea objects are left protruding from the ocean floor, and thereby presenting a hazard to navigation or fishing, they must be identified with a Coast Guard approved navigational marking.

Order No. 2

This Order concerns procedures for drilling of wells. It requires the lessee to submit an exploration plan and a development and production plan. Prior to commencing drilling under an approved exploration plan or a development and production plan, the lessee is required to file an application for permit to drill which includes information on well casing and cementing, blowout prevention equipment, directional surveys, mud program, well-control, and a list or description of critical drilling operations which may be performed. The Order also describes procedures and equipment to be used in each phase of the drilling operation and training requirements for lessee and drilling contractor personnel.

Order No. 3

This Order provides the procedures and regulations for plugging and abandonment of wells. The operator must comply with the minimum plugging and abandonment procedures as stated in this Order to prevent migration of formation fluids between the strata. Plugs are required above and below any perforations, fluid zones, and zones of abnormal pressure. A cement plug is required in the smallest string of casing which extends to the ocean floor and in the deepest casing string where an uncased hole exists below.

Order No. 4

This Order describes the procedures for securing an extension of a lease beyond its primary term. A lease may be extended as long as oil or gas may be produced from the lease in paying quantities. The Order specifies which tests and data are to be used to determine if a well is capable of producing in paying quantities.

Order No. 5

This Order requires the lessee to use the Best Available and Safest Technologies (BAST). The Order sets requirements for the design, installation and operation of subsurface safety devices, surface production safety systems, welding and burning practices and procedures, safety device testing and training, and failure and inventory reporting systems.

Order No. 6

This Order is under development. The Order will set forth requirements for completing wells and conducting workover operations.

Order No. 7

This Order concerns the control of pollution to the marine environment and prohibits disposal of waste materials into the ocean. Pollution control equipment must be maintained or available, and an oilspill contingency plan must be submitted with each exploration plan.

Order No. 8

This Order sets requirements to be complied with by the operator in the installation and operation of all platforms and structures. The requirements of platform verification are described in the following documents:

1. "Operating Procedures for the OCS Platform Verification Program."

2. "Requirements for Verifying the Structural Integrity of OCS Platforms."

3. "Commentary on Requirements for Verifying the Structural Integrity of OCS Platforms."

Order No. 9

This Order is under development. The Order will provide approval procedures for pipelines. Both the Department of Transportation and the Department of the Interior have regulatory responsibility in this area, and this is spelled out in the Memorandum of Understanding between the two Agencies.

Order No. 10

This Order deals with sulfur in the Gulf of Mexico.

Order No. 11

This Order is under development. The Order will deal with oil and gas production rates, prevention of waste, and protection of correlative rights. Therefore, this Order specifies how an operator will comply with regulations and thus insures proper production of oil and gas and placement of facilities to maximize production while minimizing environmental impact.

Order No. 12

This Order sets forth requirements for public availability of data and records concerning offshore petroleum operations. Some information collected will be available for public inspection. However, privileged information such as geological and geophysical information pertaining to producing zones would not be available for public inspection.

Order No. 13

This Order is under development. This Order will require the accurate measurement of oil and gas production and set forth conditions under which production from several wells can be commingled.

Order No. 14

This Order is under development. The purpose of this Order is to assure diligence in the development of the OCS's natural resources by allowing limited suspensions of operations or production while the operator is waiting for the installation of equipment or granting of permits necessary for the production or transportation of oil and gas from a lease. The standards in the Order are to be strictly applied, and a suspension should be granted only if the supervisor is satisfied that it will promote the development of the lease. These Orders were newly revised effective January 1, 1980, and should not need revision within the near future.

APPENDIX F

ENDANGERED SPECIES CONSULTATION

IN REPLY REFER TO:

3315 (542)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

MAR 27 1981

Mr. Terry Leitzell
Assistant Administrator for Fisheries
National Marine Fisheries Service
Department of Commerce
Washington, D.C. 20235

Dear Mr. Leitzell:

In accordance with Section 7(a) of the Endangered Species Act, the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS) are requesting a joint regional consultation considering all of the operations pertaining to Outer Continental Shelf (OCS) oil and gas leasing and exploration in the North Atlantic area. In January 1978, the BLM requested a formal Section 7 consultation and received a biological opinion on a previous North Atlantic lease sale (OCS Sale No. 42). Another oil and gas lease sale has been proposed for this same general region (OCS Sale No. 52, October 1982) and we anticipate that additional sales will be proposed for this area at some time in the future. We believe that a joint regional consultation, addressing the impacts of regional OCS oil and gas leasing and exploration on endangered and threatened species, will be a more efficient, effective, and economical approach, than an agency-by-agency, sale-by-sale series of consultations.

It is understood that by providing us with a regional biological opinion you will not be foreclosing on opportunities to reconsider that opinion in later phases of the program, or as future sales are proposed for this region. It is our position that additional sale proposals constitute new information and that formal consultation will be reinitiated at the appropriate time. Further, it is understood that formal consultation must be reinitiated before development and production activities begin in this region. These formal procedures will take place in addition to our ongoing informal consultations presently occurring through all phases and regions of the OCS leasing program.

We consider regional consultations far more valuable than sale specific ones. Regional biological opinions enhance our ability to assess the cumulative impacts of the OCS leasing program, identify regional data gaps and research needs, and provide us with an information base onto which our agencies can build in future consultations.

My staff has been in contact with your Office of Marine Mammals and Endangered Species regarding mutually agreeable arrangements for this consultation. Accordingly, it has been agreed that Wednesday, April 22, 1981, would be a convenient and appropriate time to hold a formal consultation meeting. Further, it has been agreed that this meeting should be held in the New York OCS Office of the Bureau of Land Management.

In order to permit maximum public review of this procedure and in accordance with the regulations for implementing the National Environmental Policy Act, (40 CFR 1502.25), it is our intention to include a copy of this request and the forthcoming biological opinion in the Draft Environmental Impact Statement being prepared for proposed OCS Lease Sale No. 52. This document is scheduled to be sent to the printer during the week of August 3, 1981. Your cooperation in helping us meet this deadline will be appreciated.

If you have any questions regarding this request, please contact Ralph Ainger, Bureau of Land Management (542), Washington, D.C. 20240, (FTS) 343-6264, or Tony Ladino, New York Outer Continental Shelf Office, 26 Federal Plaza, Suite 32-120, New York, New York 10278, (FTS) 264-5580.

Sincerely yours,

Donald P. Truesdell

Assistant Director

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
3315 (542)

Memorandum

To: Director, Fish and Wildlife Service

From: Director, Bureau of Land Management

Subject: Joint Endangered Species Consultation for the North Atlantic Outer Continental Shelf Region

In accordance with Section 7(a) of the Endangered Species Act, the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS) are requesting a joint regional consultation considering all of the operations pertaining to Outer Continental Shelf (OCS) oil and gas leasing and exploration in the North Atlantic area. In January 1978, the BLM requested a formal Section 7 consultation and received a biological opinion on a previous North Atlantic lease sale (OCS Sale No. 42). Another oil and gas lease sale has been proposed for this same general region (OCS Sale No. 52, October 1982) and we anticipate that additional sales will be proposed for this area at some time in the future. We believe that a joint regional consultation, addressing the impacts of regional OCS oil and gas leasing and exploration on endangered and threatened species, will be a more efficient, effective, and economical approach, than an agency-by-agency, sale-by-sale series of consultations.

It is understood that by providing us with a regional biological opinion you will not be foreclosing on opportunities to reconsider that opinion in later phases of the program, or as future sales are proposed for this region. It is our position that additional sale proposals constitute new information and that formal consultation will be reinitiated at the appropriate time. Further, it is understood that formal consultation must be reinitiated before development and production activities begin in this region. These formal procedures will take place in addition to our ongoing informal consultations presently occurring through all phases and regions of the OCS leasing program.

We consider regional consultations far more valuable than sale specific ones. Regional biological opinions enhance our ability to assess the cumulative impacts of the OCS leasing program, identify regional data gaps and research needs, and provide us with an information base onto which our agencies can build in future consultations.

My staff has been in contact with your Office of Endangered Species regarding mutually agreeable arrangements for this consultation. Accordingly, it has been agreed that Wednesday, April 22, 1981, would be a convenient and appropriate time to hold a formal consultation meeting. Further, it has been agreed that this meeting should be held in the New York OCS Office of the Bureau of Land Management.

In order to permit maximum public review of this procedure and in accordance with the regulations for implementing the National Environmental Policy Act, (40 CFR 1502.25), it is our intention to include a copy of this request and the forthcoming biological opinion in the Draft Environmental Impact Statement being prepared for proposed OCS Lease Sale No. 52. This document is scheduled to be sent to the printer during the week of August 3, 1981. Your cooperation in helping us meet this deadline will be appreciated.

If you have any questions regarding this request, please contact Ralph Ainger, Bureau of Land Management (542), Washington, D.C. 20240, (FTS) 343-6264, or Tony Ladino, New York Outer Continental Shelf Office, 26 Federal Plaza, Suite 32-120, New York, New York 10278, (FTS) 264-5580.

Donald P Truesdell

IN REPLY REFER TO:

United States Department of the Interior

BUREAU OF LAND MANAG ENT
WASHINGTON, D.C. 2

3315 (542)

MAR 27 1981

Director, Office of
Environment and Health
OES/NEH, Room 7820
Department of State
2201 C Street, N.W.
Washington, D.C. 20520

Attn: Ms. Irene Dybalski

Dear Ms. Dybalski:

Enclosed are copies of the correspondence sent to the National Marine Fisheries Service and the U.S. Fish and Wildlife Service requesting a joint (Bureau of Land Management and U.S. Geological Survey) regional consultation on the Outer Continental Shelf (OCS) oil and gas program in the U.S. North Atlantic region.

If you have any questions regarding this matter, please contact Ralph Ainger (BLM-542) in Washington, D.C. at FTS 343-6264.

Sincerely yours,

Donald P. Truedell

Assistant Director

Enclosures

United States Department of the Interior

ADDRESS ONLY THE DIRECTOR, FISH AND WILDLIFE SERVICE

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

In Reply Refer To:
BLM/GS-81-2

APR 15 1981

MEMORANDUM

540

To: Director, Bureau of Land Management
Director, U.S. Geological Survey

From: Acting Director

Subject: Joint Endangered Species Consultation for the North Atlantic Outer Continental Shelf Region (OCS) (OCS Sale 52)

This acknowledges receipt of your memorandum of March 27, 1981, requesting formal consultation on oil and gas leasing and exploration activities in the North Atlantic. Although this consultation was stimulated by the proposed OCS Sale 52, we understand from your request that you wish the consultation to consider the impacts of regional OCS leasing and exploration activities on Endangered and Threatened species. The consultation will attempt to do this with the understanding that such a regional approach will not preclude the possibility of Section 7 consultation on later phases of this program or on future sales proposed for this area.

The following people have been appointed to conduct this Section 7 consultation:

Wayne Milstead, Office of Endangered Species, Washington, D.C. - leader

Jim Michaels, Office of Endangered Species, Washington, D.C.

Andy Moser, Endangered Species staff, Annapolis Area Office

Unless otherwise required, further contacts will be made with Ralph Ainger, Bureau of Land Management, Washington, D.C., or Tony Ladino, New York Outer Continental Shelf Office, New York.

Harold J. O'Connor

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
New York Outer Continental Shelf Office
Federal Building, Suite 32-120
26 Federal Plaza
New York, New York 10278

IN REPLY REFER TO
6840

APR 22 1981

The following is a list of endangered and threatened species that we have identified as possibly being impacted by OCS oil and gas activities in the North Atlantic region:

Bald eagle	Haliaeetus leucocephalus
American peregrine falcon	Falco peregrinus anatum
Arctic peregrine falcon	Falco peregrinus tundrius
Eskimo curlew	Numenius borealis
Shortnose sturgeon	Acipenser brevirostrum
Loggerhead turtle	Caretta caretta
Green sea turtle	Chelonia mydas
Leatherback turtle	Dermochelys coriacea
Hawksbill turtle	Eretmochelys imbricata
Atlantic ridley turtle	Lepidochelys kempi
Fin whale	Balaenoptera physalus
Blue whale	Balaenoptera musculus
Sei whale	Balaenoptera borealis
Right whale	Eubalaena glacialis
Sperm whale	Physeter catodon
Humpback whale	Megaptera novaengliae

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

In Reply Refer To:
FWS/OES BLM/GS 81-2

JUL 30 1981

Memorandum

To: Director, Bureau of Land Management
Director, U.S. Geological Survey

From: ACTING Chief, Office of Endangered Species

Subject: Section 7 Biological Opinion, Proposed Outer Continental Shelf Oil and Gas Leasing and Exploration in the North Atlantic Region

A regional Outer Continental Shelf (OCS) consultation under Section 7 of the Endangered Species Act (ESA) of 1973, as amended, was formally requested by the Bureau of Land Management (BLM) and the U.S. Geological Survey (GS) on May 1, 1981. To assist me with the preparation of this biological opinion, I appointed the following individuals to conduct the Section 7 consultation: Wayne Milstead, Leader, and Jim Michaels, Office of Endangered Species; and Andy Moser, Endangered Species staff, Annapolis Area Office. A meeting was held on April 22, 1981, to discuss OCS oil and gas leasing and exploration for Sale #52 and, in general, leasing in the North Atlantic Region, and the potential impacts the proposal might inflict on listed species. In attendance were representatives from BLM, GS, the National Marine Fisheries Service (NMFS), and the Fish and Wildlife Service (FWS).

Project Description

The subject proposal provided for the leasing and exploration of select submerged Federal lands offshore of Long Island, New York. Also included in this consultation was the evaluation of a region of the North Atlantic from within which future submerged Federal lands may be leased.

The proposed Sale #52 considers the leasing of 540 tracts comprising approximately 3.1 million acres of submerged Federal lands. The tracts range in distance offshore from 80 to 164 statute miles. The depth of the submerged lands within the sale area range from 171 to 9,285 feet.

The boundaries for the North Atlantic Region include all offshore Federal land located from the United States-Canadian border, south to the east tip of Long Island, and then east to the 200-mile international boundary.

Existing support facilities which now service the Mid-Atlantic OCS Sale #59 are expected to service OCS Sale #52. A support base is located at Davisville, Rhode Island, with a heliport located at Hyannis, Massachusetts. Should the hydrocarbon reserves prove to be higher in quantity than anticipated (High Case), additional facilities during the production phase could be located at existing ports at Staten Island, New York, and Portsmouth, New Hampshire. No support base will be established at a new location.

Oil recovered during the production phase of the OCS would be taken along existing non-OCS related tanker routes to existing refineries located in New Jersey and Philadelphia (Mean Case). If large amounts of oil are uncovered, a tanker route to Gulf of Mexico refinery facilities may be established. No pipelines for oil transfer are proposed for OCS Sale #52.

Natural gas recovered from the sale area would be piped ashore to new storage and processing facilities located at Newport County, Rhode Island, and if recovered in high quantity, to Barnstable County, Massachusetts.

The proposed Sale #52 is scheduled for lease in August 1982, with subsequent exploration for hydrocarbons beginning in 1985 by the leasees. With authority from GS, production in the area could begin in 1995, and continue through 2031.

During the exploration phase, essentially no additional support facilities will be required. Drilling will entail floating drill vessels rather than permanent drill platforms.

This Section 7 consultation considers leasing and exploration activities relative to the proposed OCS Sale #52 as presented at the April 22, 1981, meeting with BLM. In addition to the direct effects of these activities, the consultation must also consider the indirect cumulative effects of the activities that are interrelated or interdependent with the proposed activity or programs.

Cumulative Effects

OCS Sale #52, as proposed, will not require the construction of any additional support facilities during the leasing and exploration phases. Therefore, cumulative effects beyond this phase would occur only if significant quantities of hydrocarbon suitable for commercial development are discovered. Should oil discoveries lead to commercial production, additional facilities might be necessary. This is particularly true should additional tracts be offered in other parts of the entire Region under consideration, especially north of the tracts proposed specifically for Sale #52. Any future tract proposals and subsequent production for the North Atlantic Region may necessitate development of additional gas pipelines and increased barge or tanker traffic to onshore oil collecting facilities and production plants.

The High Case oil resource estimated for Sale #52 indicates that 30 permanent drill platforms would be constructed to recover hydrocarbons. With future leases from the North Atlantic Region seemingly inevitable, a cumulative increase in the number of these tracts is assured. The development/production phase of Sale #52

will not require the additional construction of any refineries; however, the development of future lease sales in the North Atlantic or in the nearby Mid-Atlantic Region could necessitate additional refinery construction. It is conceivable that additional lease sales and production in the North Atlantic could require the construction of additional gas pipelines, onshore storage facilities, and gas processing plants. Construction of these potential development/production-related facilities could have an effect on listed species.

As an example, development of onshore natural gas processing facilities, hydrocarbon storage facilities, or refinery construction along coastal Maine could impact the nesting and wintering habitat of the bald eagle. The increased secondary impacts resulting from human influx into coastal Maine, such as housing, commercial, and institutional developments, not to mention increased vehicle activities, would contribute to the degradation of bald eagle habitat.

Similar impacts would result if development of coastal barrier islands were allowed to occur. Coastal barrier islands are essential habitat to migrating peregrine falcons from southern Maine south to Cape Cod (Bollengier). But all these indirect, interrelated, and interdependent effects would presumably result only if hydrocarbons are discovered in sufficient quantities to support a production phase. Since the specific location, nature, and size of facilities that may be necessary under the development/production phase is so imprecisely known at this time, and since both BLM and GS recognize that any additional and separate Section 7 consultations would be necessary prior to any development/production, consultation on the precise nature of any cumulative effects beyond the exploration stage should appropriately take place when development/production plans are presented for approval. The Service is advising that the following activities, although not the direct subject to this consultation, could affect listed species along the North Atlantic coast.

1. Future projects to prevent beach erosion, dredging projects, and port improvements or expansions may impact coastal listed species.

2. The possible sitings of liquified natural gas and oil refinery facilities may impact listed species. Impacts could result from the location of the facilities and transportation routes associated with the movement of gas or oil from the offshore area to onshore facilities. Increased chronic oil pollution and the possibility of a large spill from either pipelines or barges/tankers may affect local areas and listed species found in those areas.

3. Numerous coastal development projects will continue to reduce the habitat of listed species. Of particular concern is the loss of nesting habitat for the bald eagle and the alteration of migratory corridors for peregrine falcons.

Long-term increase of these and other activities, alone or in combination, may exceed the tolerance level of listed species and may adversely affect them.

BLM and GS should be aware of these activities and their potential for affecting listed species. This potential should be considered during any planning of OCS

development/production activities and additional OCS sales in this Region. Both agencies should expend every effort to meet their obligation to conserve listed species through all phases of OCS activities.

Oilspill Probabilities

Information on the probabilities for the occurrence of oilspills and the potential movement and impact of spilled oil upon the North Atlantic coast were obtained from the GS report, An Oilspill Risk Analysis For The North Atlantic (Proposed Sale 52) Outer Continental Shelf Lease Area, 1981.

According to this analysis, the expected number of oilspills of 1,000 barrels or greater within the life of the proposed sale is 10.24. The number of spills greater than 1,000 barrels expected to occur from Sale #52 plus existing lease sales (Nos. 40, 42, 49, and 59) is 24.62. The expected number of spills greater than 1,000 barrels resulting from existing transportation is 93.41.

The oilspill risk analysis also expresses the percent chance of one or more spills occurring and contacting various land segments or specified targets over the expected 30-year production life of the lease area. The Atlantic shoreline was divided into 35 segments of approximately 30 km in length that extend from segment 1 near Morehead City, North Carolina, north to segment 34 near the United States-Canada border. Land segment 35 is located on the extreme southeastern tip of Nova Scotia. The highest probabilities of oilspills resulting from proposed Sale #52 activities projected to reach land segments along the North Atlantic occurred at segment 24, Martha's Vineyard, and 25, Nantucket Island. The probability of oil reaching these areas from the proposal within 30 days is 20 and 25 percent, respectively. The probability of an oilspill from Sale #52 contaminating the coastline north of Cape Cod is nil.

The cumulative effects of oil contamination from existing sales on the North Atlantic Region are significant. For example, the probabilities of an oilspill originating from the combined Mid-Atlantic Sales (Nos. 40, 49, and 59) reaching land segments 10, 11, and 12 along the New Jersey coast within 30 days are 15, 25, and 0 percent, respectively. The probability of oil reaching the same segment from proposed Sale #52 are 2, 1, and 4 percent, respectively. This illustrates the potential for cumulative impacts from oilspills on peregrine falcon hacking and migratory areas, and the compounding of these problems by the sale of future tracts. Because of this, it is important that BLM and GS consult with FWS over any future proposed lease sales, development/production plans, or changes in statistical data.

Species Accounts

Your request for consultation included the following species that are under the jurisdiction of FWS: the bald eagle (Haliaeetus leucocephalus), the American peregrine falcon (Falco peregrinus anatum), the Arctic peregrine falcon (F. p. tundrius), and the Eskimo curlew (Numenius borealis). The Plymouth red-bellied turtle (Pseudemys [=Chrysemys] rubriventris bangsi), although not affected by

this sale, may be affected by future sales in the North Atlantic Region and should be considered for inclusion in future consultations. The project's potential impacts on the first four of these listed species, along with recommendations for reducing any adverse affects, are provided in the following individual species accounts.

Eskimo Curlew (<u>Numenius</u> <u>borealis</u>)

The Eskimo curlew has not been sighted for many years in the North Atlantic area. Presently, it is thought to be extirpated in the Eastern United States. Therefore, the activities expected to result from leasing and exploration in the North Atlantic Region are not expected to affect the Eskimo curlew. Should new information indicate that this species may occur in the North Atlantic Region, Section 7 consultation will be required if it is determined that the activities may affect it.

Bald Eagle (<u>Haliaeetus</u> <u>leucocephalus</u>)

The bald eagle was originally considered to have two distinct subspecies, with the southern subspecies being listed as Endangered in the <u>Federal</u> <u>Register</u>, March 11, 1967. The entire species was listed as Endangered in 43 of the lower 48 States, and as Threatened in the remaining five States on February 14, 1978. The bald eagle populations occurring in the area which may be impacted by oil-related activities within the North Atlantic Region are listed as Endangered. Critical Habitat has not been determined for the bald eagle.

Bald eagles nest along coastal areas of the United States in the States of Maine, New Jersey, and Delaware. Of these active sites, New Jersey had one bald eagle nesting territory in Cumberland County during the 1981 breeding season. Delaware had four active territories: one in Gumburro Swamp at the headwaters of the Pocomoke River, one at Bombay Hook National Wildlife Refuge (NWR), one newly discovered nest near Harbeson, and a nest near Millsboro. Of 33 nest territories located along the coast of Maine, 23 were either occupied or active in 1980. Twenty-two of the known nesting territories are listed on offshore islands. The Maine coast supports more than 75 percent of that State's resident breeding and wintering eagle population and is also used by spring and fall migrants. The entire Maine bald eagle breeding population represents more than 90 percent of the known eagle population breeding in the Northeastern U.S. (Refer and Schettig, 1980).

Bald eagles are opportunistic feeders, and fish, waterfowl, and shorebirds, as well as carrion, are included in their diet. Maine eagles increasingly depend upon birds as a food source during winter. Avian remains constitute over 80 percent of eagle food debris in coastal Maine on a year-round basis. Twenty different species of waterfowl and seabirds are represented in the food remains beneath nests, and more than 50 percent of these are from black ducks and gulls (Refer and Schettig, 1980).

Potential impacts to bald eagles resulting from OCS leasing and exploration activities include the disruption of nesting activities from the construction of onshore facilities, the possibilities of an oilspill reaching the coast and

contaminating the eagle's prey base, or the possibility of an eagle coming into direct contact with oil and contaminating its feathers or transferring oil from its feathers to its eggs. Toxicological studies have indicated that small amounts of oil applied to an egg are toxic to the embryo. However, based on information provided by GS and BLM, the possibility of an oilspill occurring during exploration activities is minimal. The GS oilspill risk analysis predicts that there is a low probability of an oilspill reaching and contaminating bald eagle habitat, and the onshore facilities for leasing and exploration activities will be primarily those already in existence. It should be noted that the State of New York, in an effort to reestablish the bald eagle in that State, is considering hacking eagles near the eastern tip of Long Island. Although no determination has been made, the State's five year reintroduction plan identifies Gardner Island, South Fork Island, or Shelter Island as a potential recipient for the transplants.

Arctic and American Peregrine Falcon (*Falco peregrinus tundrius* and *F. p. anatum*)

The peregrine is a medium-sized falcon which has been listed as Endangered since 1970. Critical Habitat for *F. p. anatum* has only been designated in California.

The principle cause of the peregrine's decline was the contamination of its prey base by chlorinated hydrocarbon pesticides. Other factors contributing to their decline include shooting, predation (particularly by great horned owls), egg collecting, disease, falconers, human disturbance at nesting sites, and loss of habitat due to human encroachment. The peregrine feeds mostly on a wide variety of birds, particularly on shorebirds during the fall migration, and occasionally on small mammals. Peregrines will kill and consume oiled birds and in doing so ingest considerable numbers of feathers with their meal. Evidence on the impact of ingested oil on peregrines is inconclusive.

The Arctic peregrine breeds in the North American tundra and migrates along the east coast where it is the most common of the two subspecies. Although a few pairs still breed in Eastern Canada, the Eastern United States population of the American peregrine is considered to have been extirpated. However, as a result of the captive-breeding program at Cornell University, peregrine falcons have been reintroduced into the Northeastern United States. There are indications that this reintroduction effort is becoming successful: several pairs are now producing young in New Hampshire and New Jersey.

Within the area expected to be impacted by proposed Sale #52, Cornell University has established four hacking sites designated for releasing captive-reared peregrine falcons: Sedge Island and Manahawkin near Barnegat Bay NWR, Brigantine NWR, and Cape May County, all in New Jersey.

In 1980, for the first time since the inception of the Cornell project, previously released captive-reared peregrines nested and successfully fledged young at Manahawkin and Brigantine NWR, New Jersey. A pair returned to Manahawkin in 1981 to successfully fledge two young of their own and fostered and fledged three additional young. Four peregrines were successfully hacked and fledged at the Cape May site. The other two hack sites were not successful in 1981.

Since existing facilities will be used for leasing and exploration and the potential for an oilspill resulting from exploration activities is small, it is not likely that Cornell's experimental release project will be affected by the leasing and exploration activities resulting from proposed Sale #52.

During migration, coastal habitats are used extensively by peregrine falcons. While the entire barrier island system throughout the North and Mid-Atlantic area is important to migrating peregrines, certain locations, because of geographic configuration, wilderness aspects, and/or habitat type, are significant staging or concentration areas and consequently have particular value for peregrine falcons. These areas include: Casco Bay Area, Maine; Monomoy Island, Massachusetts; Block Island, Rhode Island; Fisher's, Fire, and Coney Island, New York; and Sandy Hook, Island Beach State Park, and Cape May Point, New Jersey (Clark).

Peregrines are also found as far as 300 miles offshore during the migration period. Since they are capable of feeding while in flight, it is possible that spills which remain offshore can result in the oiling of peregrines or their prey. In addition, peregrines which rest on beaches during migration may become oiled (Ward, personnal communication).

Dr. F. Prescott Ward, Ecology Branch, Department of the Army, captured and released an oiled peregrine in the course of his peregrine falcon migration study at Chincoteague NWR. The bird was subsequently encountered a total of 36 times by Dr. Ward, during which time the effects of oiling on the peregrine were documented. Generally, feather wear was quite dramatic, as feathers became matted and eventually were worn down or broken. This condition likely compromises the flight and predatory capabilities of the peregrine and decreases the probability that migration will be successfully accomplished.

The probability of a spill occurring during exploration activities, however, is very small. The oilspill risk analysis provided by GS indicates that in the event of an oilspill originating in the area of Sale #52, the probability of the spill reaching the New Jersey coast where hacking has occurred within 30 days would be less than 10 percent. Loss of onshore migratory bird habitat should not occur since new facilities are not expected to be constructed.

Biological Opinion

After review of material provided by BLM and GS along with information contained in our files and information from various experts on the listed species, it is my biological opinion that the subject OCS Sale #52 and subsequent exploration activites are not likely to jeopardize the continued existence of the bald eagle, the Arctic and American peregrine falcon, and the Eskimo curlew.

This biological opinion is premised on information provided by GS and BLM that the ports and support facilities currently in existence and in use for exploration activities in the Mid-Atlantic will also be used for exploration in Sale #52. Consultation must be reinitiated should additional onshore facilities be developed which may affect listed species. You must also reinitiate consultation if a new species which may be affected should be listed, or additional pertinent information becomes available, or the project description, as discussed above, be changed.

In light of the high probabilities of oilspills that are associated with the expected life of Sale #52, BLM and GS shall also initiate Section 7 consultation when plans for development/production of Sale #52 are submitted for review to GS, including the planning of pipeline routes. Furthermore, BLM and GS are reminded of the requirements of Section 7(d) of the ESA, stating that after initiating consultation, a Federal agency shall not make any irreversible or irretrievable commitments of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would avoid jeopardizing the continued existence of any Endangered or Threatened species.

It has been recognized from previous OCS consultations that there is often a need for additional studies to better assess the impacts of OCS activities on listed species. Reliable information on listed species collected in the early planning stages of OCS development could avoid untimely delays in the commercial production phase. As previously mentioned, the peregrine falcon has been observed as far as 300 miles offshore, and they are capable of feeding on the wing. Since drill platforms may be eventually located some distance offshore, I would recommend that you initiate investigations into the number of falcons utilizing these distant offshore migratory routes as well as the incidence of feeding on the wing (and, therefore, possibly picking up oiled prey) over these areas of potential oilspills. Such information could be of value in evaluating the potential impact of oil production on peregrines.

I am requesting that BLM and GS remain in close contact with Endangered Species personnel in developing tankering routes, the development of oilspill contingency plans, and, if a future event necessitates, oilspill cleaning operations.

We wish to express the Service's gratitude to BLM and GS for their assistance in this consultation and in their sincere efforts to meet responsibilities under the ESA. Should you require clarification of items in this opinion or desire future assistance, we will be pleased to respond.

Jamie Hill

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APPENDIX G

DEEPWATER TECHNOLOGY

Appendix G. Deepwater Technology

Tentative tract selection for proposed OCS Sale No. 52 consists of 540 tracts in the Georges Bank Basin Region of the North Atlantic. Three hundred thirty-eight of these tracts lie in water depths greater than 300 meters. The maximum depth is found on Tract 52-540 (Block NJ 19-2-300) at approximately 2830 meters. Present oil industry technology is capable of exploring for, developing and transporting to onshore facilities potential reserves from those tracts in water depths to just over 1000 feet. Beyond that depth (and out to the maximum depth encountered in the sale area) the necessary exploratory equipment is apparently available and much of the production gear is in various stages of design, development, or prototype production. The technology and equipment presently available or projected for deepwater operations will be discussed in the following sections.

Deepwater Exploration

Presently there are several operational drilling facilities capable of exploring for oil in water depths as great as 8000 feet or more. Drillships and semi-submersibles are most commonly used for deepwater drilling. The drillship Discoverer Seven Seas, operated by the Offshore Company, recently set the current deepwater record by operating in just under 5000 feet of water. Global Marine's Glomar Explorer, equipped with a recently developed free-standing drilling riser, is reportedly capable of drilling in 13,000 feet of water. Sedco International also has a series of drillships designed to explore for oil and gas in up to 8000 foot water depths.

Semi-submersible rigs, although they offer less storage capacity in terms of weight than drillships, are inherently more stable and thus more applicable in certain areas and weather conditions. Roll seldom exceeds 5° on a properly found vessel, even in the most severe seas (U.S. Dept. of Interior, BLM, 1980). The Sedco 709 semi-submersible rig is equipped with features which will enable it to operate in 8000 foot water depths.

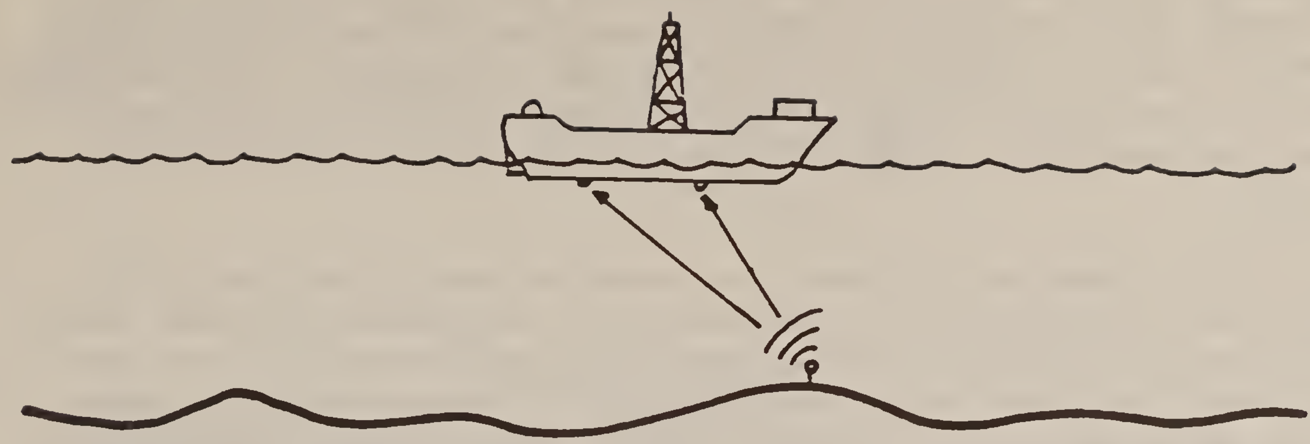
Several innovations in equipment and technology are responsible for the extreme deepwater capabilities of the presently available equipment. Modifications and improvements to existing blow-out preventers (BOP) and marine risers have been partially responsible. The BOP is a high-pressure valve, usually hydraulically operated, fitted to the top of the casing of a drilling well to prevent an accidental blow-out of oil or gas (Bank of Scotland, 1975). The BOP must be capable of fast response to potential well control problems regardless of water depth. BOPs designed for shallow water operation exhibited undesirable reaction times for preventer activation. Development of new electro-hydraulic control systems for activating the ram and annular preventers of the BOP resulted in quicker response times. The BOP must also be designed and manufactured to tolerate the large loads imposed on it by the deepsea risers. The BOPs found on several of Sedco's drillships are 39 feet tall and weigh approximately 400,000 pounds.

Marine riser systems also had to undergo modification to alleviate the up and down wave movement associated with floating drilling operations. The marine riser is a tube running from the BOP, which is situated on the sea-bed, to the drilling rig at the surface, enabling drilling fluid to be returned to the surface (Bank of Scotland, 1975). This problem was dealt with by installing slip-joints in appropriate locations of the riser and by installing riser tensioning units to balance out the rising and falling motions of the rig or vessel.

Two of the most significant innovations in the development of deepwater drilling technology have been the use of guidelineless re-entry and dynamic positioning. Guidelineless re-entry uses acoustical/subsea television equipment to guide the drill string into a wellhead funnel thousands of feet below the surface of the water (McNally and Hale, 1979).

Dynamic positioning, the concept of remaining in one spot at sea without anchors, was originally proposed for the National Science Foundation Project Mohole to drill through the earth's inner mantle underlying ultra deep 20,000 foot water depths. Today, dynamic positioning is being applied to the deepwater search for natural resources. Advances in control sophistication, reliability, and power output allows present dynamic systems to keep rigs on station for extended periods.

The system provides a means of automatically maintaining the position of a free-floating vessel within specific tolerances by using thrust vectors to counter the forces of wind, waves, and currents that tend to displace a vessel from a desired location. The dynamic positioning system consists essentially of a position referencing unit, a dynamic positioning controller, and the thrusters. The taut wire position referencing unit uses a weighted line extending from the sea floor to a two-axis inclinometer that reads the rope angle as it deviates from the vertical. The resulting data is fed to the controller unit. Acoustic referencing is accomplished by either the short-base, ultra short-base, or long-base configuration. The short-base system uses an acoustic beacon (transponder) on the ocean bottom and several hydrophones on the vessel. The beacon transmits pulses (at regular intervals) which are received at the same instant by the hydrophones when the rig is exactly on-station. As the vessel drifts off-station the acoustic wave is received at different times as individual hydrophone-to-transponder distance varies. Vessel pitch, roll, and heave, is compensated for by a Vertical Reference Unit which applies appropriate corrections to the data prior to transmittal to the controller. The converse of the short-line system is the long-line system in which the hydrophones are mounted on the ocean bottom and the beacon located on the vessel. This arrangement eliminates pitch and roll inaccuracies, and, since the baseline between transponders is large, it is very accurate. A variation on the short-line system is the ultra short baseline or phase comparison system. This system determines direction from a measurement of the phase of the acoustic signal received by three closely spaced sensors within a single assembly. The basic configuration of the three reference systems is shown on Figure 1.



SHORT BASELINE SYSTEM

ULTRA SHORT BASELINE SYSTEM

LONG BASELINE SYSTEM

Figure One: Acoustic position referencing systems

The data from the reference systems are fed into the error compensators that generate error signals which are proportional to the difference between actual and desired position. These data are in turn fed into the Dynamic Position Controller. The computers of the controller unit analyze the input data, apply modifications or add information through software, and act as the system interface to the thrusters. The thrusters (either fixed or omni-directional) are positioned and actuated by the commands from the controller. The thrusters develop up to 3000 hp for station-keeping.

In the event that a computer malfunction, weather conditions, or other factors result in a "driveoff" of a dynamically positioned drilling vessel (a condition in which the vessel moves away from its' position over the well), provisions are aboard for disconnection of the upper BOP package and riser from the lower BOP stack (Albers, 1980). A programmed sequence of events results in the closing of certain valves on the lower stack and unlocking of the riser connector. Several deep water drilling vessels are equipped also with riser recoil preventor systems which prevent the slip joints of the riser system from slamming together and transferring the impact energy of the system to the drilling vessel structure.

There are currently several deepwater facilities equipped with dynamic positioning systems. Among this group are the Sedco 709 semi-submersible, the three drillships of the Sedco 400 series, the Glomar Explorer, and the Offshore Company's drillship Discover Seven Seas. As prospects for deep ocean oil and gas increase, more deepwater exploration drilling rigs and ships equipped with dynamic positioning systems will undoubtedly be manufactured and utilized. To date, no unusual problems have been encountered in any present deep-water exploratory drilling operations.

Deepwater Development and Production

Production capability for deepwater extraction of hydrocarbons generally lags some eight years behind exploration technology, according to one industry expert (Albers, 1980). However, new designs and models for deepwater production are now being developed. Some technically innovative equipment is presently or will soon be available for application.

To date, conventional fixed platforms have been used for major deepwater discoveries in water depths to just over 1000 feet. Figure 2 reflects the growth in offshore production platform size, from 1974 through 1978. Shell's Cognac platform lying in approximately 1025 feet of water fifteen miles from the mouth of the Mississippi River, is presently the world's tallest and heaviest steel production platform. With drilling rigs atop, it stands 1265 feet tall and weighs approximately 59,000 tons. (Shell Oil Company, 1979). The Cognac platform is unconventional in that it was fabricated in three sections and set one on top of the other at the site, due to the fact that no facilities were available where a one piece section of that size could be built.

An innovative new rig design for production is Exxon's guyed tower. It is a bottom-founded structure that differs significantly from conventional

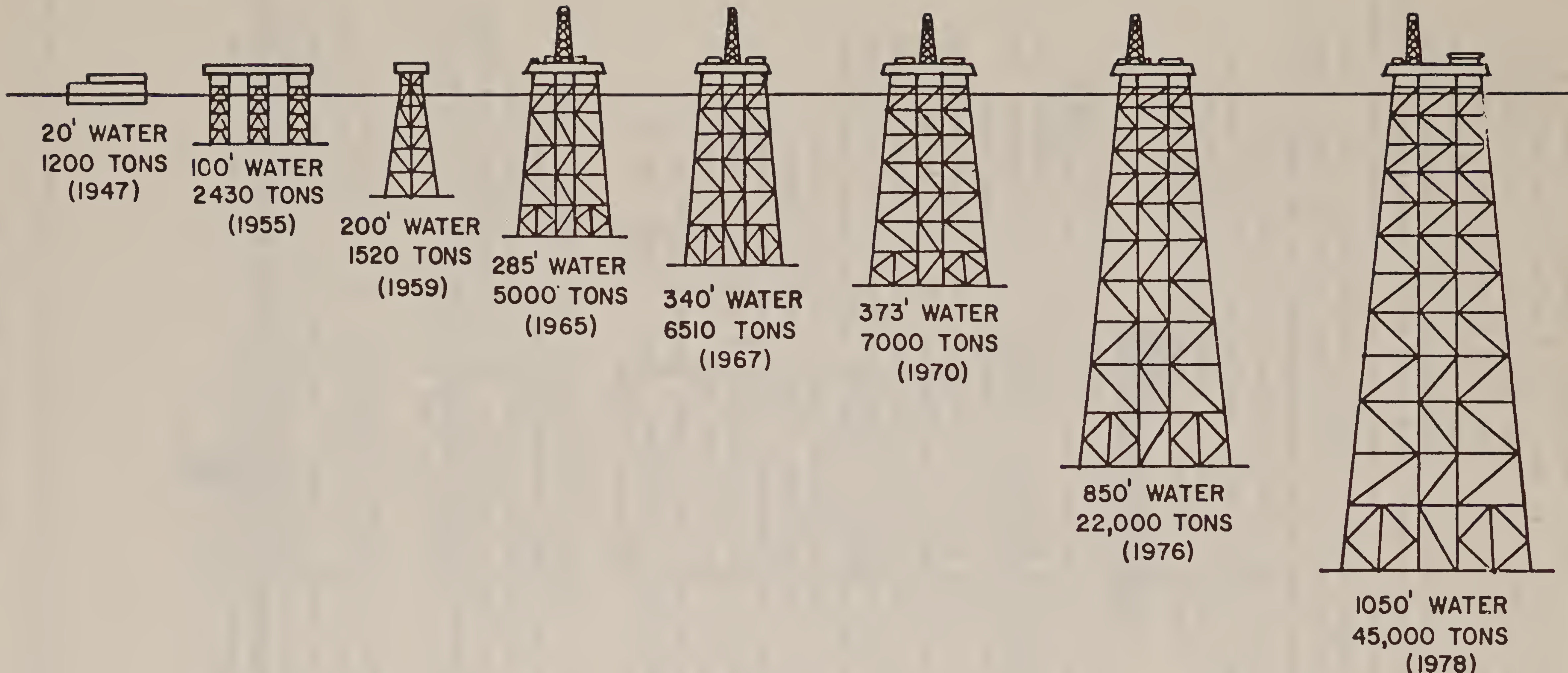


Figure Two; Evolution of offshore production platforms

platforms in several aspects. It is a "compliant" structure in that it moves in response to applied forces. It also is a trussed structure with constant cross-section from top to bottom and, though it is bottom mounted, it does not utilize a system of piles for stability (Power et al., 1978). The tower essentially consists of a blunt-nosed, truss-reinforced spud can that is forced into the sea floor during installation, the constant cross-section tower jacket, and the deck - much like that of a conventional platform. The tower is held in the vertical by a series of radial guy-wires that attach to the deck by wedge-type clamps that also serve as tensioners. The lines then pass down the side of the structure to fairleads about 50 feet below the water line, and (at about a 30° angle) to clump weights on the ocean floor. Design criteria call for the clump weights to partially lift off the bottom during passage of storm waves, while under extreme weather conditions they may lift entirely. Beyond the weights, the guy system terminates at anchor piles. Figure 3 shows the general configuration of the system.

Following preliminary analysis of the concept, a 1/5 scale model of the tower (intended for 1500 foot application) was fabricated and installed in 293 feet of water in the Gulf of Mexico. Installation was completed utilizing conventional offshore construction equipment and procedures that would be employed for a full-scale prototype. However, the test tower was fabricated and installed in one section whereas a full-scale one would be completed in two or more sections, floated to the site, and joined prior to implantation on the bottom. Analysis of acquired data on tower motions compared well with analytical predictions based on measured wave profiles. Also, measured maximum guy-wire tensions compared well against predicted tensions. The practicality of the design has been indicated by the performance of the model since installation in October 1975. Exxon is considering the guyed tower as one alternative for producing deepwater tracts in the Mississippi Canyon area of the Gulf of Mexico. Present plans call for installation of a guyed tower in 1200 feet of water 65 miles southeast of Grand Isle, Lousisiana, in the same general location as Shell's Cognac platform. Exxon feels the guyed tower concept can be extended into waters 2500 to 3000 feet deep (Bleakley, 1980).

Another innovative concept for deepwater production (and probably the most feasible design for extreme water depths) is Conoco's tension leg platform. This platform is scheduled for operation on the Hutton Field in the North Sea by 1984. The TLP is basically a semi-submersible, although it will be larger than any presently available semi-submersible. Figure 4 shows the general configuration of a tension leg platform.

Conoco's platform will be attached to the ocean floor by 12 tethered or tension legs 9 inches in diameter. The tension legs will be in four groups, comprised of 3 tension legs at each corner of the platform. They will be attached to the seafloor by anchoring templates, previously drilled and cemented in. The tension legs can be reduced or lengthened. At each end of the tether is a locking assembly fitted with a flex joint. The locking

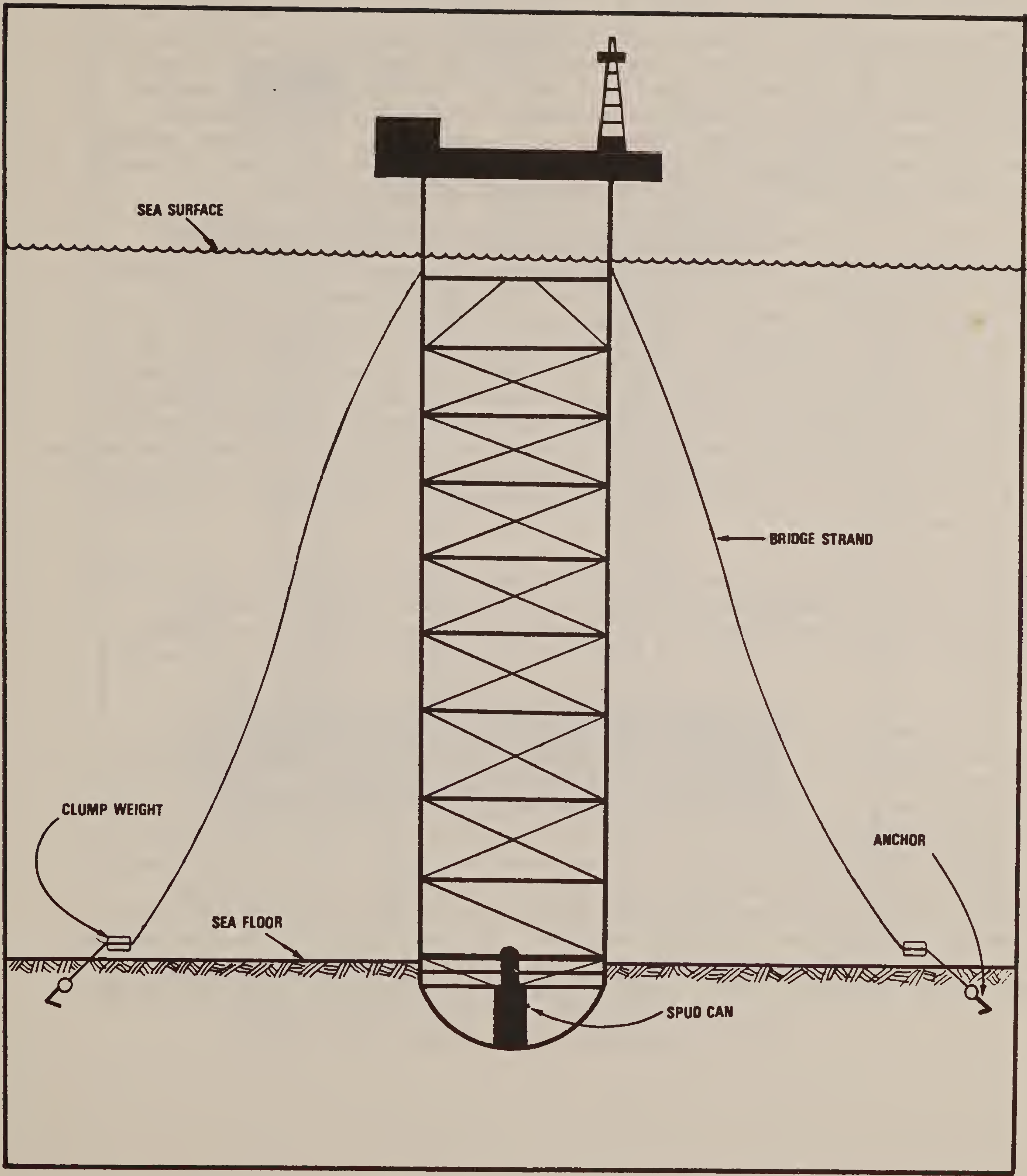


Figure Three: Guyed Tower
(After Kraft, Campbell, and Ploessel, 1979)

feature will allow the TLP to connect its 12 tethers to the seafloor anchoring systems by stabbing them into the locking mechanism, without diver assistance. Later, they can be automatically released and recovered for replacement, maintenance, or relocation of the rig. Once anchored the TLP is pulled down on the tethers, resulting in 1000 tons of tension on each of the 12 tethers. The legs will be in tension rather than compression like bottom supported platforms and their length will have far less structural significance. When tension is applied the platform will have virtually no vertical motion, although the flex joints will permit approximately 79 feet of lateral motion in heavy weather. At this point, the force on the tethers will be nearly 200 tons each, acting to restore the legs to a vertical position. Conoco's TLP is designed to withstand effects of the 100-year northern North Sea storm, with a 98 foot wave and 98 mph wind, although most of the waves expected to be encountered will be of smaller magnitude and shorter periods (Ives, 1980). Although Conoco's design has an expected maximum depth capability of 2000 feet, oil industry experts feel that the tension leg platform could be operated in 6000 feet of water with some experience and additional engineering (Rogers, 1980).

Gulf Research and Development and British Petroleum have both recently come up with their own radical modifications to Conoco's basic TLP design. Gulf's modification to the TLP configuration incorporates a hexagonal leg hull with wells through each leg and a track encircling the deck upon which the rotary rig rests. The tensioning members are incorporated in each of the legs. Gulf engineers feel that the hexagonal hull configuration will be less sensitive to wind and wave direction and severity (Offshore, 1980). The BP design utilizes a four-leg hull of square configuration also with separate tensioning members in each of the four legs. In addition to the guyed tower and TLP, Shell Oil is experimenting with new designs which they feel are feasible to water depths of about 6000 ft. (Shell Oil - personal communication).

A major contribution to deepwater oil and gas production may be made by the subsea completion/production systems now in various stages of design, development, and installation. An ideal system for extreme deepwater production should be able to be installed and operated without the use of divers.

The most common type of subsea completion is the satellite well system. This is basically a single well completed on the sea floor and connected by flow lines to a remote central facility. Satellite well systems may be either "wet" or "dry". A wet system consists of a Christmas tree and other components which are exposed to ambient sea floor conditions. Wet subsea completion systems have been made diverless by the development of through-flow-line/pump down tool systems (TFL/PDT). These systems provide a method for conducting operations by pumping tools through flow lines and into and out of tubing strings. A closed hydraulic system is used with fluid pressure providing energy to a piston attached to a service tool string (Morrill, 1980). Figure 5 shows a subsea tree equipped for TFL

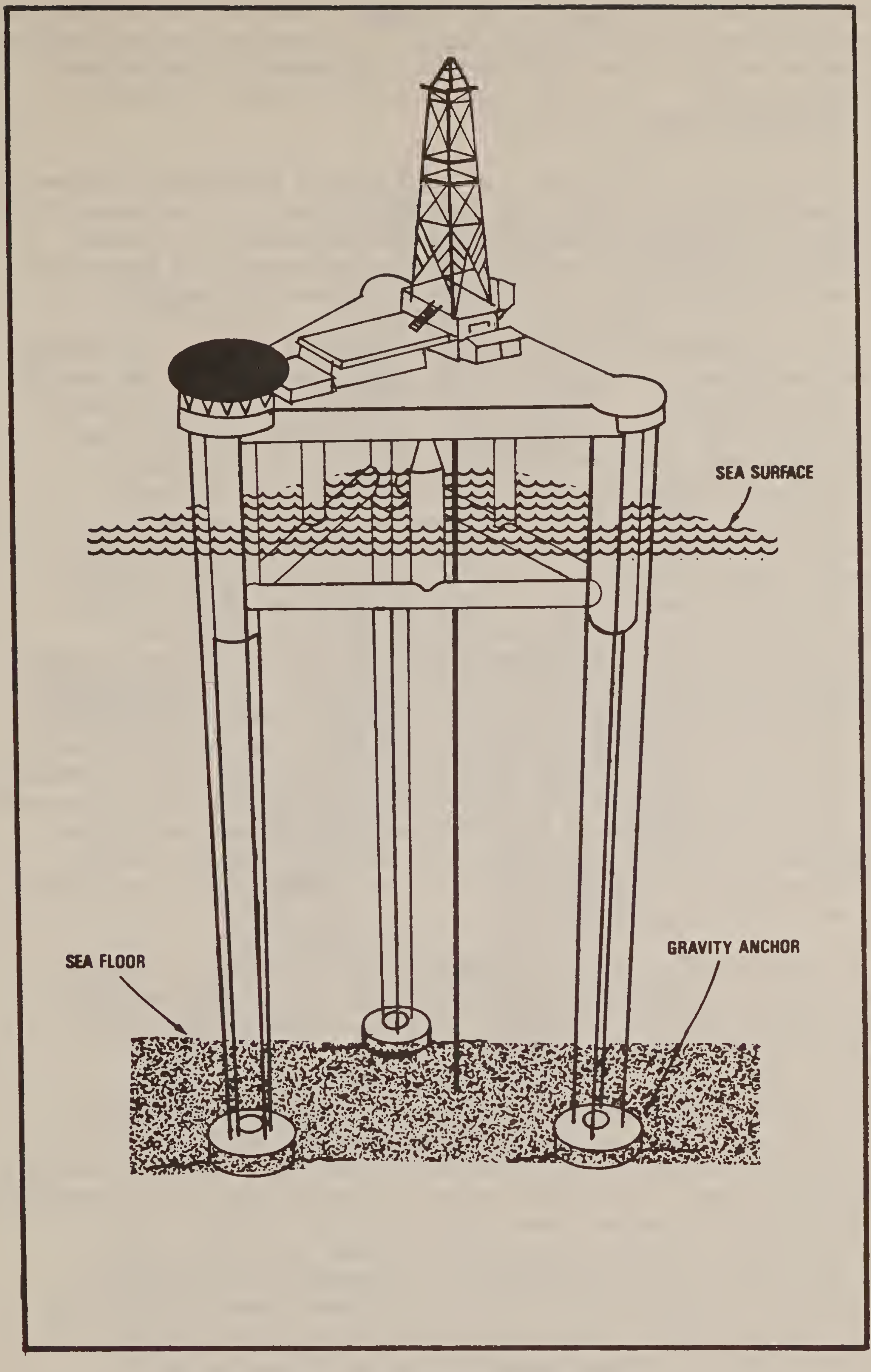


Figure Four: Tension Leg Platform
(After Kraft, Campbell, and Ploessel, 1979)

maintenance and diverless installation. Diverless flowline pull-in and connection systems are contained in this set-up, as well as a diverless control module, and a pop-up buoy system which allows for the reestablishment of guidelines in deep water (Mason, 1980). Oil industry personnel claim a system such as this can be installed at any water depth.

Exxon Production Research has developed a 'wet' Subsea Production System (SPS) which has undergone extensive land and subsea tests. The system consists of a large template supporting several subsystems designed for various functions of oil and gas production. Thhe system is capable of deepwater operation and can be serviced by remote controlled manipulators.

The template is a large tabular structure used to carry all of the subarea equipment to the sea floor and to provide for easy alignment of the wells and pipelines to the manifold. Enclosed by the template are the various subsystems - the manifold, pump and separator, the completed wells and Christmas trees. The main component of the system is the rectangular production manifold containing the piping to carry out the various operations. It is fail-safe (all valves close on loss of hydraulic pressure) and designed for use with pump-down tools for well tests and other assignments. The manifold is ready to handle production from the time the wells start to flow until the field is abandoned. All joints are either metal-to-metal or 100% x-rayed welds for long-life and reliability. The SPS is designed to permit replacement of malfunctioning components without need for divers. This is carried out by a 68,000 pound Maintenance Manipulator (remotely operated via surface support vessels) that brings a new piece of equipment down to the unit, replaces the faulty gear, and returns to the surface with the old one. The manipulator maneuvers within the SPS template on tracks that bring all replaceable components within reach. It carries TV equipment and lights to aid in surface controlled operation of the unit. The only components of SPS that are not bottom replaceable are the sea floor template and the wellheads. An overall view of the SPS System is shown on Figure 6.

The piping of the manifold surrounds the wells that are to be produced by the system. They are rigged for pump-down tools, are equipped with down-hole safety valves below the mudline, and have conventional fail-safe master valves in the Christmas tree.

After extensive land tests, a complete SPS was installed in West Delta Block 74 off Louisiana. Three wells were tapped by the unit that in turn processed the 500 barrel/day oil flow and transferred it to a nearby platform. During the test (that lasted over two years) the SPS was maintained by the Remote Manipulator lowered from surface support vessels. The manipulator successfully completed more than 50 work missions during the test. The long-term test was designed to demonstrate the ability of the SPS to function successfully in the ocean environment, to perform reliably over a period of time, and to provide data on the economic feasibility of the design. Future operation and modification of the

SATELLITE TREE
(with TFL)

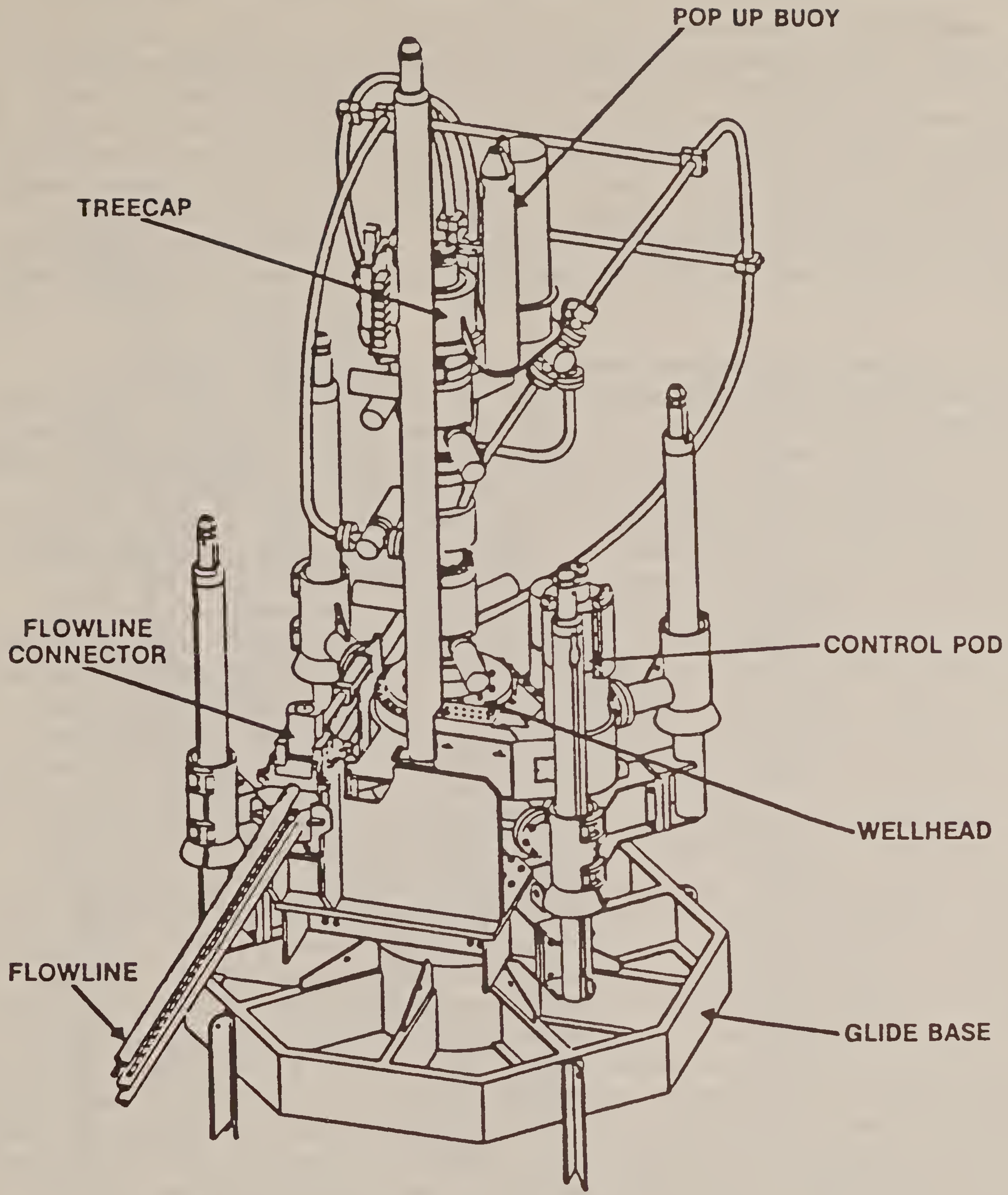


Figure Five: Satellite well system
(From Mason, 1980)

Exxon SPS may allow for its placement in unlimited water depths. At the present time Exxon Production Research believes the system can be safely operated in depths of 6000 ft. or more (personal communication-Exxon).

Subsea completion systems may also be "dry" systems. A dry completion is one in which the wellhead equipment is enclosed within a chamber and is accessible by attachment of a manned bell (especially designed to mate with the subsea unit) lowered by surface support vessels. An advantage of the dry system is that well control lines and the flowline can be connected from inside the chamber (U.S. Dept. of Interior, BLM, 1980). Water depth is not critical in the installation of dry systems as the chamber wall thickness can always be increased accordingly. As submersible technology expands to greater depths, dry subsea completions become more economically feasible.

Shell Oil Company and Lockheed Petroleum Services joined efforts to develop and field test a dry ocean floor completion system for completing and producing several wells as a single system. The system is based on the concept of housing more or less standard equipment in one-atmosphere chambers. Components of the subsea system include wellhead cellars, distribution lines, and the Production Manifold. This manifold (also a one-atmosphere unit) is the core of the system. It acts as the central gathering point for the wells in the field, and contains all equipment necessary to transfer the gas and oil to a floating or fixed platform facility for further processing. Connecting lines between the wellheads and production manifold are connected to the units through an inclined opening in the sides of the chambers called the 'bullnose port'. Flexible oil/gas lines are pulled into the ports via a cable and winch system inside the wellhead cellar or manifold. The system is completely diverless and all components are maintained at one atmosphere of pressure. It is fully automated for remote operation, is capable of through-flow-line (TFL) tool operation, and can be designed for any water depth (ETA Offshore Seminars, Inc.). Two examples of the Lockheed system wellhead equipment are shown in Figure 7. These one atmosphere units are permanently installed on the wellhead - the upper hatch indicating where the service capsule is attached. A system was installed in 1972 in the Gulf of Mexico Main Pass Block 290 in 375 feet of water. No major problems have been encountered in the operation of the system since installation. In September 1976 a three-well subsea system was installed in the Eugene Island Block 331 Field. The wellhead cellar in this installation is supported on the casing head housing and is surrounded by the guide frame whose base is 2 to 5 feet above the sea floor. All of the equipment and materials were carefully selected for the appropriate pressure rating and subjected to extensive testing prior to installation. Every well is equipped with automatic fail-close valves and remote shut-in controls actuated hydraulically from the platform to which the produce flows. Shell/Lockheed feel the system may be adaptable to depths of 6500 feet or more.

The majority of actual working subsea completion systems to date have been installed in low pressure, shallow water environments (less than 85 feet). More than 300 subsea completions have been made in Lake Erie since

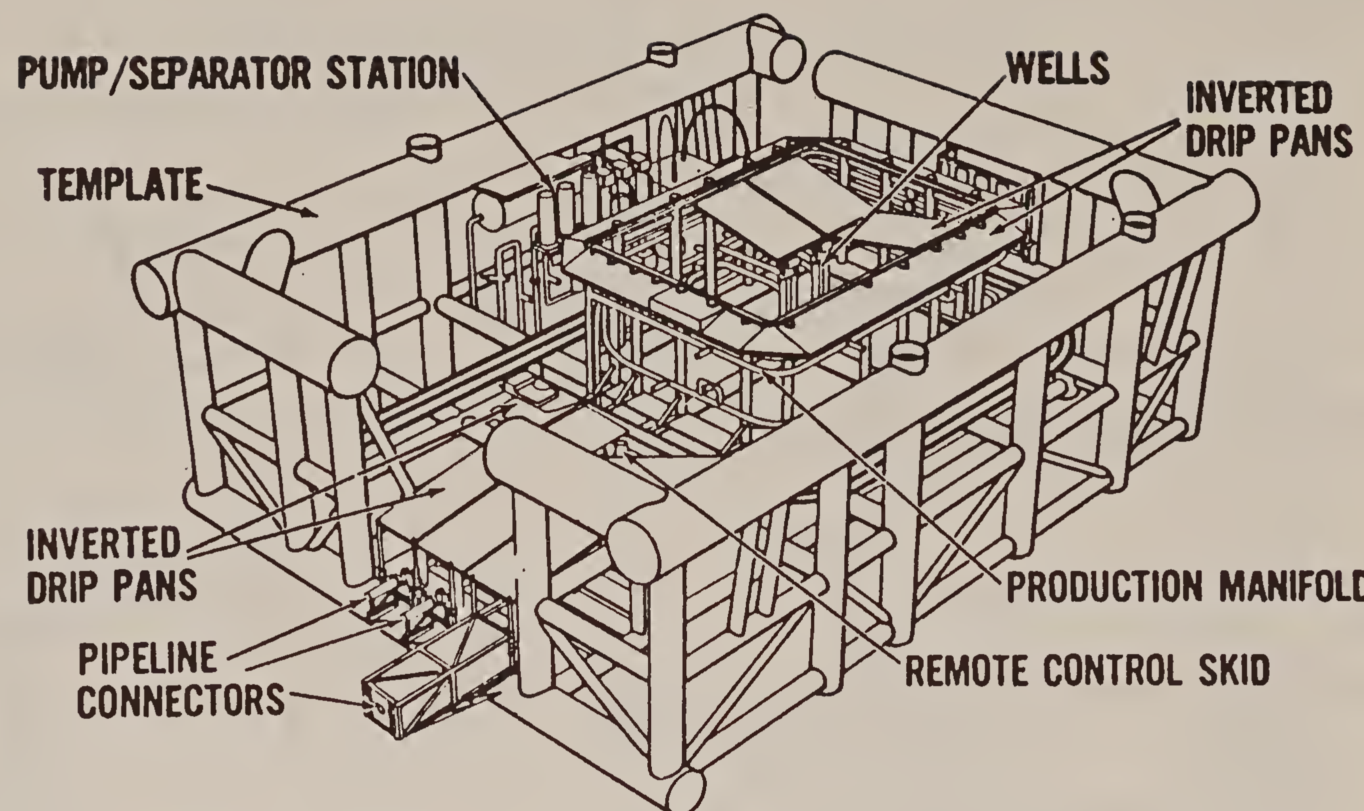


Figure Six: Exxon Subsea Production System (SPS)
(From Snyder and McKinney, 1978)

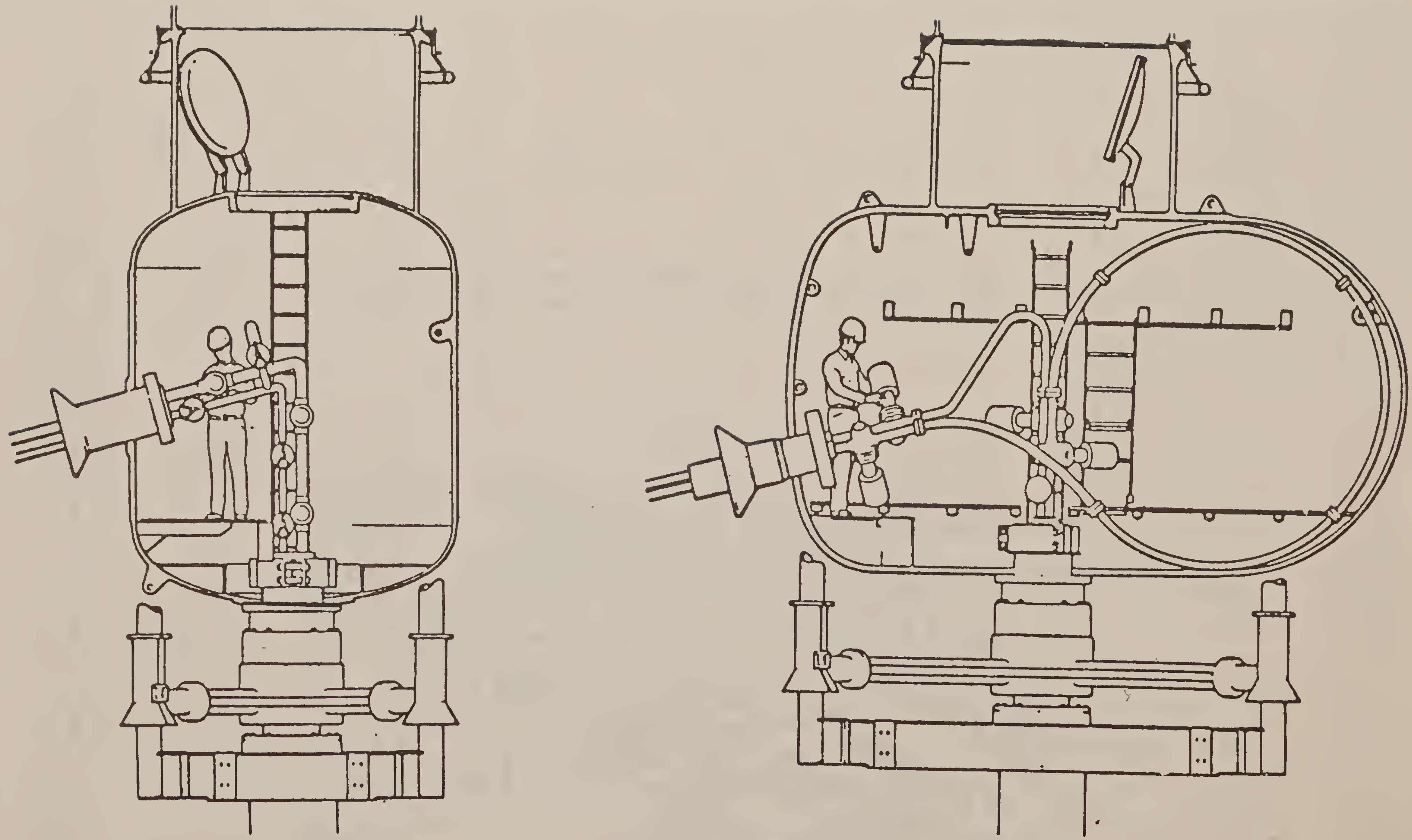


Figure Seven: Lockheed One-Atmosphere Subsea Completion System
a. For wellhead installation where TFL tools are not required.
b. A wellhead cellar designed to enclose the TFL tubing loop.

Source: Lockheed Petroleum Services, Ltd.

the first known underwater North American completion was made there in 1943. One hundred-six subsea completions were made worldwide between 1960 and 1974 (U.S. Dept. of Interior, BLM, New Orleans, 1980). Lockheed Petroleum currently holds the world deep-water record after installation of a subsea production system at a depth of 198 m (620 ft) offshore Brazil. There were approximately 21 subsea wells completed on the sea floor in 1979 and about 59 subsea trees are presently on order (Mason, 1980). No operating or safety-related problems have been encountered under actual working conditions of the subsea networks operating presently.

If hydrocarbons in economically producible quantities are found in the proposed Sale No. 59 area, facilities for transportation of the oil or gas to onshore facilities for processing must be made available. The oil/gas products may either be transported to land by tankers after being pumped to the surface or transported by pipelines.

Pipelines may be installed using several different techniques. Two of the most applicable approaches to deepwater placement of pipelines would seem to be the use of either a reel barge or a dynamically positioned semi-submersible platform. The semi-submersible barge is similar to a conventional lay barge in that it is equipped with a production ramp, welding station, facilities for coating the welded joints, tensioners, devices for lowering the pipe overboard, etc., and is self-propelled. The semi-submersible, however, is able to perform in more severe weather and wave conditions. With dynamic positioning aboard, the platform can maintain a more accurate and precise position while pipe is being laid. As the vessel advances by using anchoring lines, position is maintained by thruster control. This negates the effects of yaw or turning tendencies which normally might be present. A general configuration of this set-up is illustrated in Figure 8.

The traditional method of laying marine pipelines is to join the sections of pipe on the lay vessel. In this method the pipe is placed aboard in 40 to 80 foot sections. During lay operations several sections are positioned and the joints welded simultaneously on a long, gently curved production ramp. The joints are then x-rayed and protectively coated. When these operations are complete, the vessel is moved forward by winching in on the anchoring lines. The pipe leaves the vessel via the stinger, a device designed to help limit the stress imposed on the pipe as it is laid. Tensioners along the production ramp provide a hold-back force, which limits the curvature of the pipe string, holding the strain on the pipe to a minimum. For deepwater laying operations a curved stinger or ramp must be used. This allows the pipe to leave the vessel at a steeper angle, and settle to the bottom in a 'J' curve greatly reducing pipe stress. Shallow water operations place the pipe on the bottom in an 'S' curve. The differences in these configurations are illustrated in Figures 9A and 9B. Figure 9B shows a variation or extension of the stinger method for deeper water. This variation utilizes an inclined ramp in place of the stinger. The ramp is hinged to the lay vessel and thus the angle can be adjusted as water depth changes. It is presently believed that the inclined ramp method could be effective to water depths as great as 9000 feet (Weaver, 1980a).

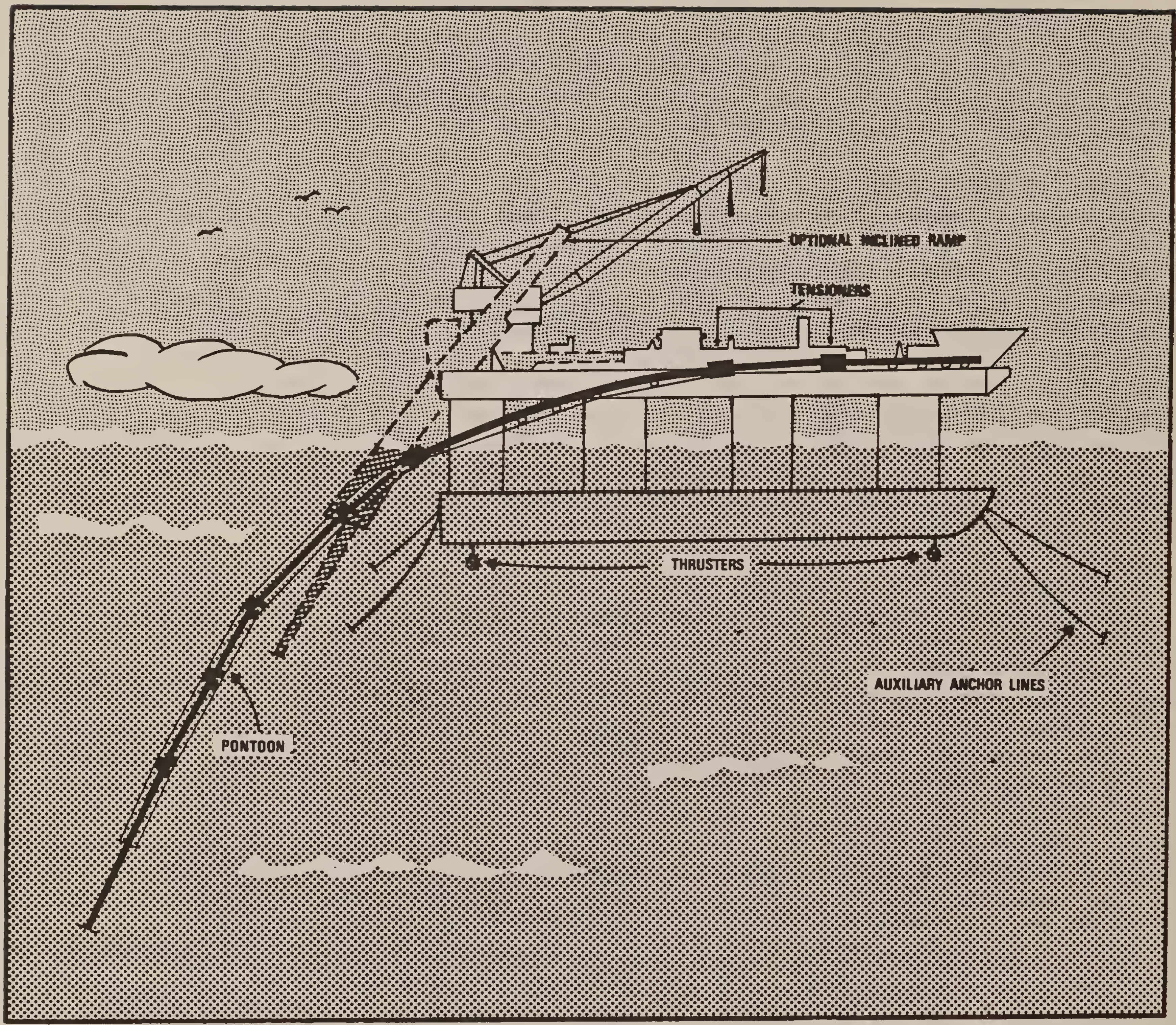


Figure Eight: Dynamically-positioned semisubmersible lay barge
(After Gorden and Rochelle, 1976)

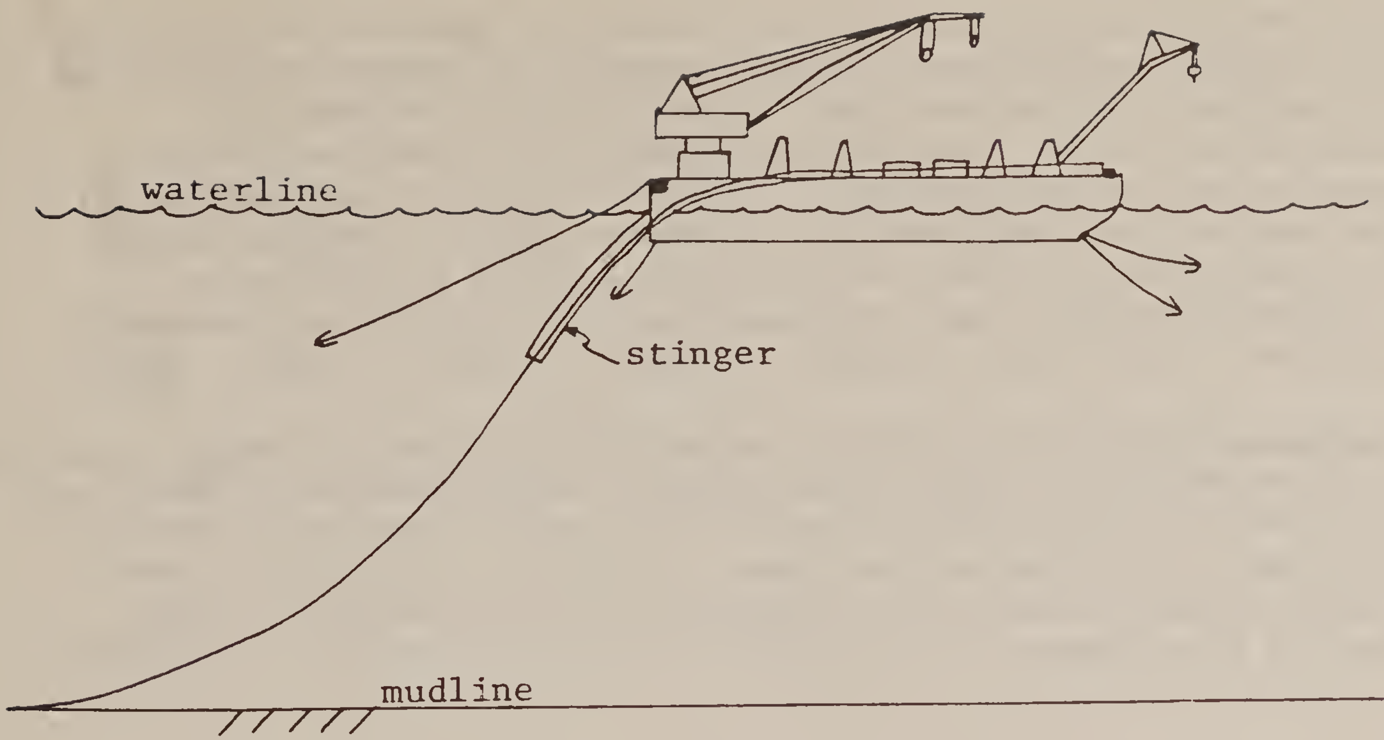


Figure Nine A: Lay barge with stinger showing 'S' curve developed during lay operation.
(After Gordon and Rochelle, 1976)

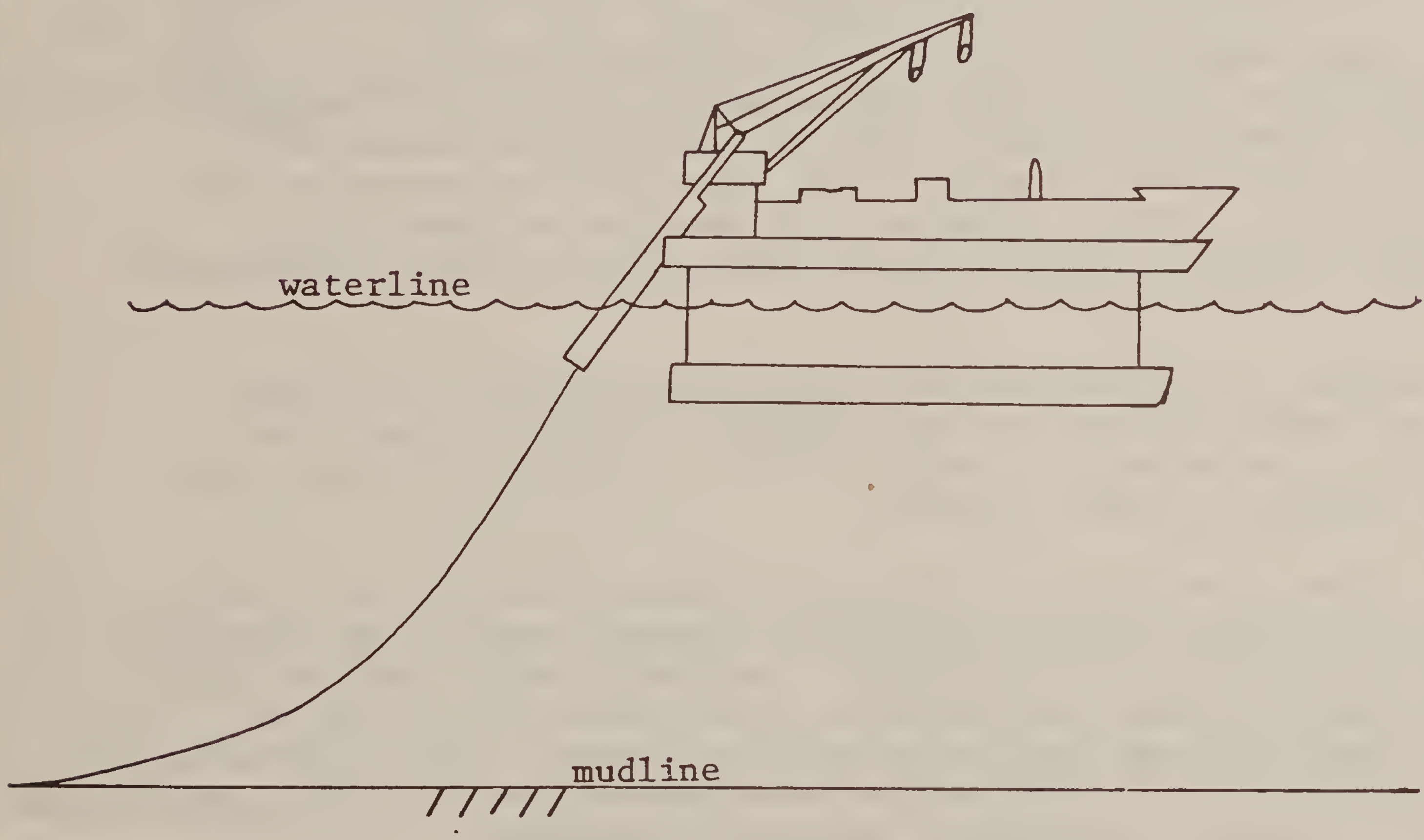


Figure Nine B; Inclined ramp/curved stinger 'J' curve developed during lay operation.
(After Gordon and Rochelle, 1976)

The dynamically-positioned semi-submersible Castoro VI, operated by the Saipem Co., recently established a world's record in deepwater pipelaying by laying a 20 inch gas line across a 608 m deep (2000 ft) section of Mediterranean seabed along the trans-Mediterranean route from Tunisia to Sicily. A recent report by the Bechtel Co. indicates that a semi-submersible rig such as the Castoro Sei, equipped with a rotary rig for vertical laying of pipeline would be feasible beyond water depths of 3000 ft. (Offshore, July, 1980). Saipem officials feel confident that the Castoro Sei presently has the capabilities to lay pipe to depths of 6000 to 7000 ft. (Hale, 1980).

The reel lay method utilizes a continuous string of pipe that has been joined ashore and wound onto a reel on the vessel. Reel diameter is such that only plastic deformation of the pipe occurs. At location, the end of the previously laid pipe is attached to the pipe on the reel. The pipe is then fed from the reel through a gear that straightens the pipe before it goes overboard. Maximum pipe diameter for laying by the reel method is presently 16 inches.

A new concept in the laying of deepwater pipelines by the reel method is the construction of Santa Fe's self-propelled, vertical reel layship Apache, which recently laid and connected four flowlines and two control umbilicals for British Petroleum. An illustration of the Apache can be seen in Figure 10. The ship is 404 feet long and can carry 2000 tons of pipe 5000 miles at 12.5 knots. In addition, it is dynamically positioned by four 800 hp thrusters for lay operations (Jorgensen, 1980). The Apache is presently capable of laying 16 inch pipe in water depths around 610 meters (2000 ft.) and smaller lines in water depths of 915 m (3000 ft).

Deepwater pipelines may also be laid by the flotation method - a 10 inch line was laid in Lake Geneva at 1100 feet using flotation. In this method the pipe is welded ashore in long sections, flotation is attached to counteract pipe weight, and the pipe is then towed to location and joined to previous sections of pipe. Submergence of the pipe may take place via conventional stinger methods or by regulating the flotation to gradually lower the string to the bottom.

It is also possible to install pipe by pulling long strings of it along the bottom - at times into pre-trenched channels. As in the flotation method the pipe is assembled in a nearby facility, welded, and then pulled (rather than floated) to final location.

In addition to pipe stress, the problems of fatigue, buckling, etc., must be overcome in deepwater pipeline operations. Dynamic analysis of pipeline installation is a necessity for deepwater. Sea state, vessel motions, pipe diameter and weight, stinger configuration, pipe tension etc., must be considered in evaluating any pipelaying operation (Mason, 1980). Concentrated industry research and effort have led to development of complex and sophisticated computer codes for dynamic analysis of deepwater operations.

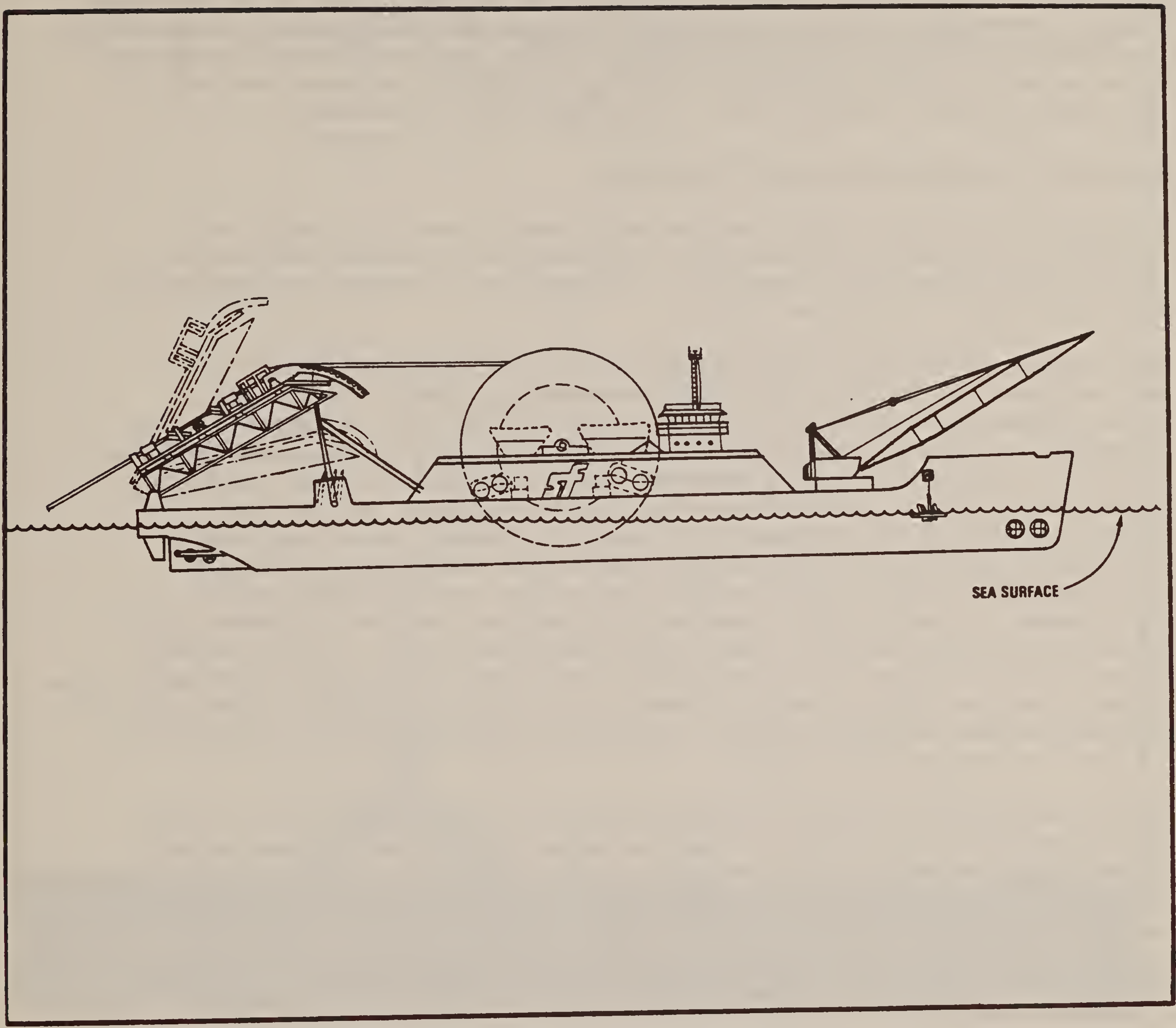


Figure Ten: Apache reel pipelay ship
(After Friman, Uyeda, and Bidstrup, 1978).

In many cases it is desirable (or required by regulations) to protect the laid pipeline from environmental effects such as scour, and man-induced damage to fishing or vessel anchoring. The classic method of pipe burial has been jetting air and water at up to 25,000 psi on the bottom adjacent to the previously laid pipe. The pipe would then sink into the depression. However, this method is not always effective and it may cause the soils to lose normal structural properties. A unique approach to deepwater trenching has been undertaken by Norway's state-owned oil company, Statoil. They have developed a remote trenching unit, connected by umbilical cords to a surface ship. The system utilizes acoustic position-referencing systems and computer interfacing. Figure 11 shows the general operation of this unit. A dual narrow-beam scanning sonar unit serves as the basic sensor for locating the pipe and aligning the vehicle with it during mating. Subsea televisions serve as backup to the sonar for trenching purposes. Deepwater testing of the system has been completed and no problems were encountered.

Deepwater Drilling and Blowout Prevention

Blowouts are the most costly and dangerous hazard associated with the operation of an oil or gas platform. A blowout is an accidental escape of oil or gas from a well caused by a sudden loss of control in underground pressures (Bank of Scotland, 1975).

The USGS has maintained a computerized file of all blowouts which have occurred on the OCS since 1971 (Danenberger, 1980). During the 8-year period from 1971-78, 46 blowouts, all in the Gulf of Mexico, occurred: 17 during exploratory operations, 13 during development drilling, 5 during production, 8 during workover activities, and 3 during completion activities. Most of these blowouts had short durations and involved minimal amounts of oil spillage. In cases of blowouts occurring during development drilling for natural gas, wells have been kmown to release gas around the outside of the surface casing for several months after the blowout. In most cases, however, well control was reestablished within a relatively short period of time with minimal gas loss. The most severe blowout in U.S. waters during this time period occurred during operations (nondrilling) on Gulf of Mexico Eugene Island Block 215 in 1971 when an oil pump on the platform exploded, destroying the platform and resulting in a fire which burned for 55 days.

Controlling and/or preventing blowouts during deepwater operations is not significantly different than in shallow water operations. In most cases, proper analysis and continuous and/or intermittent surveillance of the mud system being employed can detect small changes in subsurface pressure before they become visually apparent (ETA Offshore Seminars, Inc. 1976). Should monitoring of the "mud in" and "mud out" indicate an oncoming increase in pressure, the pumping down of mud can in most cases, prevent a blowout.

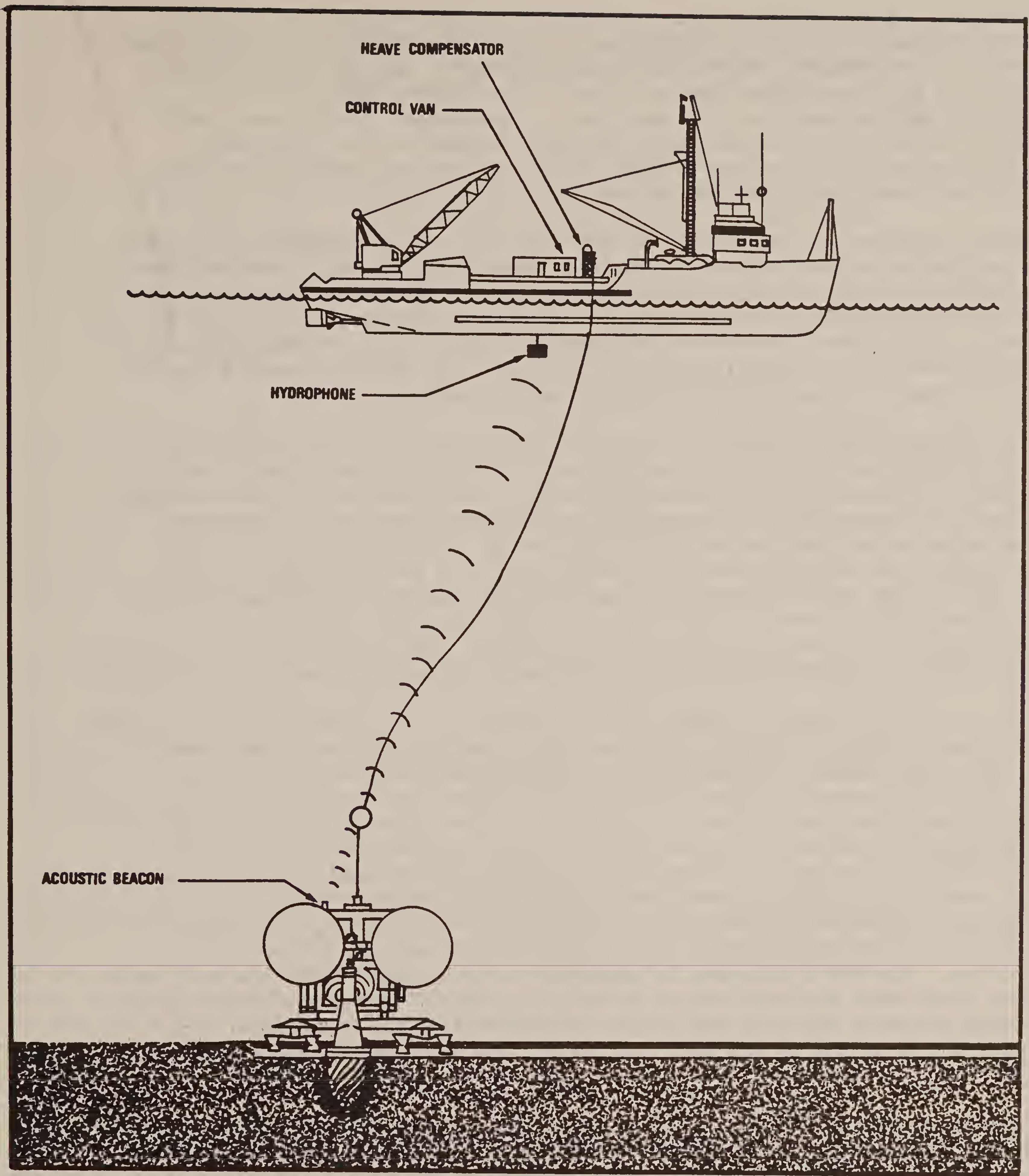


Figure Eleven: Operation of Statoil's deepwater pipeline burial system (After Petroleum Engineer International, July, 1979)

In deepwater drilling operations precise monitoring and maintenance of the mud system is particularly necessary to protect against the fracturing of surface sedimentary formations when drilling in shallow gaseous zones. Fracturing of these formations may result in a sudden influx of over-pressured shallow gas into the well bore. Daneberger (1980) notes that this can be a problem in deepwater drilling because of the relatively greater increase in pressure exerted by the mud column than the increase in pressure exerted by the overburden.

Blowouts may also be controlled through the drilling of relief wells and/or the activation of the blow-out-preventor (BOP). Relief wells are drilled to establish direct connection with the wild-well bore hole (ETA Offshore Seminars, Inc. 1976). During offshore operations within roughly the last decade, none of the blowouts which have occurred in U.S. waters required a relief well to re-establish control of the well. Many of these blowouts have "bridged" or sealed off through natural processes.

The drilling of relief wells involves the injection of heavy mud into the overpressured bore hole at a rate greater than the lifting capacity of the blowing well, until control is established. In certain cases, bottom hole pressure of the reservoir is such that it exceeds a pressure capable of being balanced by feasible mud injection rates. In this situation, the relief well may be deliberately aimed off the wild well landing point so that mud can be injected into the reservoir to plug the passageways open to the escaping reservoir fluids (ETA Offshore Seminars, Inc., 1976). After relief well operations succeed in bringing the wild-well under control, final plugging operations are still necessary to gain permanent well control.

Relief well techniques are expensive to implement, as an additional drilling rig is necessary to actually drill the relief well. At the present time, drilling rigs capable of operating in water depths as great as 6000 to 8000 ft. are extremely scarce. Only 3 dynamically positioned drillships (Discoverer Seven Seas, Sedco 471, Sedco 472) and 1 dynamically positioned semisubmersible (Sedco 709) are rated to operate at these extreme depths. Thus, rig availability is a limiting factor in the implementation of relief well techniques should a blowout occur within the proposed sale area. The timely activation of the rams on the blowout preventor (BOP) stack of the drilling system will, in most cases, prevent a catastrophic blowout from occurring. The BOP's purpose, in general, is to quickly close the well bore in the event that the well starts a "kick", a "kick" being an indication of oncoming pressure increase and influx of fluid from the formation. The quicker the response of the BOP, the faster the well can be brought under control.

An important feature of deepwater drilling operations is that the BOP is normally situated on the seafloor. This prevents a fire from reaching the wellhead and also limits the loss of the structural integrity of the iron on the wellhead (Weaver, 1980b).

Most B.O.P. systems to date have employed hydraulic control signals for activation of the rams for deepwater operations, hydraulic systems could be too slow in response time and thus ineffective in terms of blowout control. Thus, electromechanical systems have been developed for rapid BOP activation.

Cameron Iron Works, Inc. has developed a highly reliable, electrically operated blowout preventer system exclusively for use in deep water (Miller and Sowers, 1977). The system utilizes interconnecting cable harnesses which are oil-filled, pressure balanced, and activated by a low-voltage power input from the instrumentation and control circuits situated on the platform. Testing of the system proved it to be rapid, safe, and most of all, highly reliable. In addition, the cable industry has responded favorably to the BOP user's need for durable umbilicals having a fast response time (Kerr and Sawin, 1977).

A BOP system such as the one described above will probably be used on any platforms placed within the proposed sale area. In addition, designs for production platforms such as the tension leg platform (TLP) call for the installation of other safety devices. The TLP will be equipped with a safety block value on the sea floor template. This valve, with dual fail-safe operators, will be the primary control point for each well, and provides for maximum security for well control (Falkner and Franks, 1978). Rapid "shutting in" of the well at the seafloor will be possible during emergency procedures.

Available data from U.S.G.S. failure records from the Gulf of Mexico, along with A.P.I. - sponsored tests, manufacturer's field tests, etc. indicate that certain types of subsurface safety valves are extremely effective in shutting off the flow of produced oil or gas in the event of excessive pressure in (and flow from) the producing zone (Purser, 1977). There are basically two types of subsurface safety valves: "subsurface controlled" and "surface controlled".

"Surface controlled" valves close by virture of hydraulic, pneumatic, or electrical signals sent to it through control lines from the surface. "Subsurface controlled" valves close automatically at a predetermined mass flow rate through the valve. Subsurface safety valves can be placed at any vertical location between the wellhead and the well completion zone, but USGS regulations require that the device be installed at a depth of 30m (98 ft) or more below the ocean floor.

Analysis of failure rates for subsurface safety valves indicates that "subsurface controlled" valves have a significantly lower rate of failure than "surface controlled" valves (Purser, 1977). The most frequent cause of failure, by far, was erosion of the valve by sand particles (sand cutting) from produced sand. These sand particles can destroy the metal and result in leaks and failures anywhere in the

system. Purser (1977) notes that many actual blowouts could have been prevented had effective, sand-resistant, "subsurface-controlled" subsurface safety valves been installed at or near the well completion zone. Thus, the installation of such a system would be highly recommended for deep-water operations.

Predictions of the probability of a blowout occurring within the Sale No. 52 area is impossible. Danenberger (1980) has pointed out that differences in local geology (from both hazards and resource considerations) operating conditions, human factors, and technological changes make forecasting of blowouts from analysis of historical records highly misleading and inaccurate. This is especially true for frontier areas, of which the Sale No. 52 area is certainly one.

Improvements in detection and control of shallow gas can be expected, however, certainly in deepwater areas where drilling and operating costs are high. Additional improvements can also be expected in measurement-while-drilling (MWD) technology, in combating lost circulation, in mwd measurement, in understanding the frictional effects related to gas influxes, in well-control training programs and from advances in sub-surface-safety valves, completion and workover techniques (Danenberger, 1980).

Deepwater Production and Development Conclusion

The technology, expertise, and methodology are presently available to successfully explore for oil and gas in the water depths found in the proposed Sale No. 52 tracts. However, development and production technology is not at present capable of operating at extreme water depths. The prototype and drawing board equipment, methodologies, etc. indicate that the potential is not far from reality. The discovery or indication that economic quantities of oil or gas are present in the deep waters of our oceans should provide the incentive for oil industry personnel to rapidly escalate their efforts to further developm their present or proposed technologies.

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APPENDIX H

LEGAL AND ADMINISTRATIVE AUTHORITY

Appendix H. Legal and Administrative Authority

1. Outer Continental Shelf Lands Act, as amended

a. Leasing Program

The Outer Continental Shelf Lands Act (OCSLA) of 1953 (67 Stat. 462) was amended in 1978 (92 Stat. 629), and is codified at 43 U.S.C.1331. The OCSLA, as amended, authorizes the Federal leasing of lands seaward of State marine boundaries, which for the States on the Atlantic Ocean extend up to three geographical miles out from the coastline.

The OCSLA sets forth both objectives and procedures for mineral leasing for the submerged lands of the Outer Continental Shelf (OCS). The purpose of the Act, as amended, are to:

(1) establish policies and procedures for managing the oil and natural gas resources of the OCS which are intended to result in expedited exploration and development of the OCS in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade;

(2) preserve, protect, and develop oil and natural gas resources in the OCS in a manner which is consistent with the need (a) to make such resources available to meet the national's energy needs as rapidly as possible; (b) to balance orderly energy resource development with protection of the human, marine, and coastal environments; (c) to insure the public a fair and equitable return on the resources of the OCS; and (d) to preserve and maintain free enterprise competition;

(3) encourage development of new and improved technology for energy resource production which will eliminate or minimize risk of damage to the human, marine, and coastal environmens:

(4) provide states, and through states, local governments, which are impacted by OCS oil and gas exploration, development, and production with comprehensive assistance in order to anticipate and plan for such impact and, thereby, to assure adequate protection of the human environment;

(5) assure that states, and through states, local government, have timely access to information regarding activities on the OCS, and opportunity to review and comment on decisions relating to such activities in or to anticipate, ameliorate, and plan for the impacts of such activities;

(6) assure that states, and through states, local government, which are directly affected by exploration, development, and production of oil and natural gas are provided an opportunity to participate in the policy and decisionmaking process relating to management of the resources of the OCS;

(7) minimze or eliminate conflicts between the exploration, development, and production of oil and natural gas, and the recovery of other resources such as fish and shellfish;

(8) establish an oil spill liability fund to pay for the prompt removal of any oil spilled or discharged as a result of activities on the OCS and for any damages to public or private interests caused by such spills of discharges;

(9) insure that the extent of oil and natural gas resources of the OCS is assessed at the earliest practicable time; and

(10) establish a Fishermen's Contingency Fund to pay for damages to commercial fishing vessels and gear due to OCS activities.

The production prescribed to implement these objectives include (1) development of a five-year leasing program; (2) deliberation on the administration of particular sales; (3) regulatory supervision of exploration and development by lessees or their agents; (4) the establishment of compensatory funds for oil pollution and interference with fishing activities; and (5) coordination between Federal, State, and local authorities and the public throughout the leasing and development process.

Within the U.S. Department of the Interior (DOI), the Bureau of Land Management (BLM) is the administrative agency for the leasing of submerged lands, and the U.S. Geological Survey (USGS) for the supervising of operations after leases have been awarded.

Pertinent regulations under the OCSLA are those issued by BLM as to leasing operations and pipelines, and those of USGS as to exploration, development, and production operations. BLM regulations were published in the Federal Register of June 29, 1979 (44 FR 38268), effective July 30, 1979. USGS regulations were published in final form on September 14, 1979 (44 FR 53685), and on October 26, 1979 (44 FR 61886), effective December 13, 1979, as corrected on March 28, 1980 (45 FR 20464). Also, on May 2, 1980 (45 FR 29280), rules on unitization were published, effective June 30, 1980. 43 CFR 3320.2(d) provides that pursuant to Section 5(a) of the OCSLA, as amended, the Secretary may cancel a lease when:

(1) continued activities pursuant to such lease would probably cause serious harm or damage to life, property,

any mineral, national security or defense, or to the marine, coastal of human environment;

(2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and

(3) the advantages of cancellation outweigh the advantages of continuing such lease or permit in force.

The development of the five-year leasing program, the conception and coordination of environmental studies and environmental impact statements, the selection and offering of tracts, the issuance of leases and pipeline rights-of-way, and attendant title adjudication, all fall primarily within the jurisdiction of the BLM under regulations codified at 43 CFR 3300 et seq. The supervision of exploration and development is provided primarily by the USGS under 30 CFR et seq. Each agency's internal guidelines (Manuals, Delegations, Secretarial Orders, Cooperative Agreements) further specify the administrative procedures to be followed. Participation by States, localities, and the public, as well as the overlapping jurisdiction of other agencies, are highlighted separately below.

The current five-year leasing program schedules all stages of OCS sales under consideration for the period covered. The Final 5-Year OCS Oil and Gas Leasing Schedule as approved in June 1980 by the Secretary appears as Figure I.A.2. The final decision to hold a particular lease sale, or what tracts will be offered in it, is not made until the Secretary of Interior approves the final Notice of Sale which must be published in the Federal Register at least 30 days prior to the sale.

More information on the changes brought about by the OCSLA amendments and the development of the 5-Year Schedule can be found in the Final Environmental Statement on the Proposed Five-Year OCS Oil and Gas Lease Sale Schedule and in the Supplemental to this Statement.

b. Information and Coordination

The OCS Lands Act, as amended, provides a statutory foundation for the Department's policy of coordinating OCS activities with affected States and, to a more limited extent, local governments. At each step of the procedures which lead to lease issuance, participation from affected States and other interested parties is sought and encouraged.

Section 18 of the OCSLA, as amended, requires a detailed review process in developing the leasing schedule. This review involved significant participation of affected States, Federal agencies, and the public, as well as submission of the program's schedule to the President and Congress before the Final 5-Year OCS Oil and Gas Leasing Schedule was approved by the Secretary of the Interior in June 1980.

Section 19 of the OCSLA, as amended, sets forth the framework for coordination and consultation with affected States and local governments. Starting with

development of the lease schedule and through subsequent steps leading to a proposed sale - and after a sale, during review of exploration, development and production plans - DOI invites and considers suggestions from the governors of potentially affected states. Through the governors, potentially affected local governments are invited to comment.

Under Section 26 of the OCSLA, as amended, the Secretary must make available to affected States a summary of data to aid them in planning for the onshore impacts of OCS oil and gas activities. The summary includes estimates of oil and gas reserves in areas leased or to be leased, estimated size and timing of development if and when oil and/or gas is found, pipeline locations, if any, and the general location and nature of anticipated onshore facilities. A Summary Report for the North Atlantic covering OCS activities through July, 1981 is available, as noted below, from the U.S. Geological Survey.

In addition, Section 26 requires preparation and transmittal to each affected State of an index of all relevant actual or proposed programs, plans, reports, environmental impact statements, tract nominations, and other lease sale information. Upon request, the Secretary must send copies of such items to an affected State. The first Atlantic Index was published in May, 1979 in accordance with regulations of the BLM (43 CFR 3300.2) and the USGS (30 CFR 252.5). Copies of the Atlantic Index, the North Atlantic Summary Report and updates, and the Directory to Federal, State and local OCS-Related Activities and Contacts, all prepared as part of the Outer Continental Shelf Oil and Gas Information Program (OCSIP), are available from the Office of OCS Oil and Gas Information, U.S. Geological Survey, 640 National Center, Reston, VA 22092.

The organization of the National OCS Advisory Board reflects the requirement for substantial, formal state participation in OCS decisions. Under its charter, the Board consists of a Policy Committee, a Scientific Committee and six Regional Technical Working Groups. The Policy Committee performs the Board's historic function of advising the Secretary of the Interior on OCS policy matters. The Scientific Committee makes recommendations concerning the scope and direction of the Environmental Studies Program. The Regional Technical Working Groups, which include State representatives, participate in BLM's Intergovernmental Planning Program for OCS Oil and Gas Leasing, Transportation and Related Facilities. The Technical Working Groups carry out a program that was established to provide a formal mechanism for regional coordination and planning of three elements of the OCS program administered by the BLM: (1) the leasing process, (2) the Environmental Studies Program, and (3) OCS oil and gas transportation planning.

The North Atlantic Working Group has held a total of seven meetings since its inception. It has largely focused its attention on two issues, making recommendations for the Sale No. 42 Biological Task Force, and prepared Sale No. 52. For Sale No. 52, the following areas have been addressed:

1) Development of eight specific recommendations on the tract selection and identified special concerns which should be addressed in the draft impact statement. (April 1980)

2) Discussed results of field level tract selection recommendations. (April 1980)

3) Identification of issues, alternatives and scenarios to be considered for the draft impact statement. (December 1980)

In addition, the Working Group will offer recommendations on stipulations for the impact statement in July 1981 and become involved in the review of the draft Secretarial Issues Document.

c. Compensatory Funds

Offshore Oil Spill Pollution Fund: Title III of the OCSLA Amendments established in the Treasury an Offshore Oil Spill Pollution Fund. A levy of not more than 3 cents per barrel of oil produced on the OCS provides between \$100 and \$200 million to compensate for spill pollution.

Final regulations (33 CFR 135, 136) to implement this Title were published in the March 19, 1979 Federal Register. They are enforced by the Coast Guard, U.S. Department of Transportation. The claims procedures are included in Part 136 of these regulations. The address of the Fund administrator is Offshore Oil Pollution Compensation Fund, U.S. Coast Guard Headquarters (G-W/73), 400 Seventh Street, S.W., Washington, D.C. 20590.

Claims for economic loss that arise out of or directly redult from oil pollution resulting from OCS oil and gas activity may generally be asserted by any claimant for removal costs. Damages may be claimed for injury to or destruction of real or personal property, lost use of real or personal property, and injury to or lost use of natural resources, by a United States claimant who owns or leases property so damaged or who utilizes the natural resource involved. The President may assert claims for injury to or destruction of natural resources over which the Federal Government exercises sovereign rights or exclusive management authority, as may a State in regard to natural resources owned or managed by the State. Lost profits or impaired earning capacity may be claimed by a United States claimant who derives at least 25% of his earnings from activities using affected property or natural resources. Federal, State and local governments may also assert claims for tax revenue lost due to injury to real or personal property.

Owners and operators of non-public vessels transporting OCS oil and of offshore facilities are held strictly liable for claims attributable to oil pollution from their vessels or facilities. Except in cases of gross negligence, willful misconduct or violation of Federal regulations, liability is limited in the case of vessels to the greater of \$250,000 or \$300 per gross ton; an in the case of an offshore facility, liability is limited to the total of cleanup and removal costs, and \$35 million in damages. Evidence of financial responsibility adequate to satisfy the maximum amount of liability must be provided. The Administrator of the Fund can be presented with claims when all other parties deny responsibility for pollution, when the polluter is a public vessel, or when the Coast Guard is unable to designate the polluter.

Fishermen's Contingency Fund: Title IV of the OCSLA amendments established this Fund to compensate commercial fishermen for actual and consequential damages, including loss of profit due to damage or loss of fishing gear, by various materials and items associated with oil and gas exploration, development, or production on the OCS. Final regulations for the implementation of this Title were published in the Federal Register on January 24, 1980 and July 2, 1980; further regulations are proposed in the Federal Register of October 2, 1980. The Fund is administered by the Financial Services Division, National Marine Fisheries Service in the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

As required in the Act, nine Area Accounts have been established. The North Atlantic Area Account covers the area under consideration for proposed Sale No. 52. Each area account is initially funded at $100,000 and cannot exceed this amount. The account is initiated and maintained by assessing holders of leases, pipeline rights-of-way and easements, and exploration permits. These holders cannot be assessed more than $5,000 in any calendar year.

Generally, the claims eligible for compensation are as follows: 1) the damage or loss must be suffered by a commercial fisherman; and, 2) any actual or consequential damage (including loss of profits) due to damage or loss of fishing gear must be caused by items associated with oil and gas activities. Damage or loss that occurs in non-OCS waters may be eligible for compensation if the item(s) causing the damage or loss was (were) associated with OCS oil and gas activities.

Damage or losses ineligible for compensation are generally as follows: 1) those caused by items that are attributable to a financially responsible party; 2) those caused by negligence or fault of the commercial fishermen; 3) occurrences before September 18, 1978; 4) claims for more than the replacement value of the fishing gear; 5) claims for loss of Profits in excess of 6 months unless supported by records of the claimant's profits during the previous 12 months; 6) any portion of damages claimed that will be compensated by insurance; 7) claims not filed within 60 days of the discovery of the damage or loss; and, 8) damage or loss caused by a natural obstruction or an obstruction unrelated to OCS oil and gas activities.

There are several requirements for filing claims including a report within 5 days after the discovery of the damage or loss, stating among other things the location of the obstruction. A detailed claims form must be filed within 60 days of the discovery of the loss or damages. The 5 day report must be made to the nearest National Marine Fisheries Service (NMFS) Regional Office, which for the North Atlantic leasing area is in Gloucester, Mass. The detailed claims must be filed with the Chief, National Marine Fisheries Service, 3300 Whitehaven Street, N.W., Washington, D.C. 20235.

The claimant has the burden to establish all the facts to demonstrate the eligibility for the compensation, including the identity or nature of the item which caused the damage or loss and that the item is associated with OCS oil and gas activities.

Damages or losses are presumed to be caused by items associated with OCS oil and gas activities provided the claimant establishes that: 1) the commercial fishing vessel was being used for commercial fishing and was located in an area affected by OCS oil and gas activities; 2) the five-day report was filed; 3) no record of an obstruction in the immediate vicinity is in the most recent NOAA/NOS nautical charts or weekly Notice to Mariners; and, 4) no proper surface marker or lighted buoy marked the obstruction.

Damage or losses occurring within a one-quarter mile radius of obstruction recorded on charts or listed in the Notice to Mariners or properly marked are presumed to involve the recorded obstruction.

Table I.B.2. Status of Authorities which Implement the OSCLA, as Amended

Section of the OCSLA, as Amended (43 USC 1331 et seq.)	Subject	Agency	Code of Federal Regulations	Federal Register Date Announced (A) Proposed (P) Final (F)
5(a)(1)	Suspension of operations with respect to a lease	GS BLM	30 CFR 250.12 43 CFR 3319.9	Oct. 26, 1979 (F)* Jun 29, 1979 (F)**
5(a)(2)	Cancellation of a lease	BLM GS	43 CFR 3320.2 30 CFR 250.12	Jun 29, 1979 (F)** Oct 26, 1979 (F)**
5(a)(4)	Utilization, Pooling & Drilling Agreements	GS	30 CFR 250.50, 51,52	May 2, 1980 (F)
5(a)(6)	Pipeline Permission Revision	GS BLM	30 CFR 250 43 CFR 3340	Nov 10, 1980 (F) Nov 24, 1980 (F)
5(a)(8)	Air Quality standards for OCS activities	GS GS	30 CFR 250.2, 34, 57 30 CFR 250.57-1, 2	Mar 7, 1980 (F) Mar 7, 1980 (F)***
5(f)	Pipeline clarification	BLM	43 CFR 3340	Oct 17, 1980 (F)
8(a)(1)	Bidding Systems			
	-Sequential Bidding	DOE	10 CFR 376	Sep 9, 1979 (P)
	-Cash bonus bid/fixed royalty -Royalty bid/fixed cash bonus -Cash bonus bid/sliding scale royalty	DOE	10 CFR 375, 376	Feb 12, 1980 (F)
	-Fixed net profit share	DOE BLM	10 CFR 376, 390 43 CFR 3317	May 30, 1980 (F) Oct 17, 1980 (F)
	-Work commitment	DOE	10 CFR 376, 390	Jul 25, 1980 (A)

Section of the OCSLA, as Amended (43 USC 1331 et seq.)	Subject	Agency	Code of Federal Regulations	Federal Register Date Announced (A) Proposed (P) Final (F)
11(q)	Exploration plans	GS	30 CFR 250.34-1, 3, 4	Sep 14, 1979 (F)*
18(f)	OCS Leasing Program	BLM	43 CFR 3310	Jun 29, 1979 (F)**
21(a)	Study on Safety and Health Regulations	GS CG	30 CFR 250	Feb 28, 1980 (A)
25	Development and Production Plans	GS	30 CFR 250.34-2, 3, 4	Sep 14, 1979 (F)*
26	OCS Oil and Gas Information Program	GS GS BLM	30 CFR 251.14-3 30 CFR 252 43 CFR 3300.2	Jan 25, 1980 (F) Aug 7, 1979 (F) June 29, 1979 (F)

* Corrected March 28, 1980, June 5, 1980.
** September 26, 1979.
*** Comment period extended, May 2, 1980.

Section of the 1978 OCSLA, as Amended PL 95-372)	Subject	Agency	Code of Federal Regulations	Federal Register Date Announced (A) Proposed (P) Final (F)
Title III	Offshore Oil Spill Pollution Fund	Coast Guard	33 CFR 135, 136	Mar 19, 1979 (F)
		IRS	26 CFR 301	May 21, 1980 (F)
Title IV	Fishermen's Contingency Fund	NOAA	50 CFR 296	Jan 24, 1980 (F)
		NOAA		Jul 2, 1980 (F)
		NOAA		Jan. 8, 1981 (F)
		GS	30 CFR 251.5-5	Jan 25, 1980 (F)
403(b)	Marking of Equipment	GS	30 CFR 250.54	Oct 26, 1979 (F)*
604	EEO Requirements	BLM	43 CFR 35	Dec 3, 1980 (F)
606(d)(3)	Investigation of Availability of OCS Natural Gas	GS	-	Apr 23, 1980 (A)

APPENDIX I

EXPLORATION, DEVELOPMENT AND PRODUCTION ACTIVITIES

Appendix I. Exploration, Development and Production Activities

1. U.S. Department of Interior Responsibilities

The Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS) are Departmental agencies with direct OCS regulatory and enforcement authority. After the leases are issued, the primary Federal regulatory role shifts from BLM to USGS. No exploration, development, or production activity may commence on any OCS lease until an appropriate plan has been approved by USGS. These plans which must be accompanied by environmental reports describe activities to be conducted on a lease.

The Secretary cannot permit exploration unless it is determined that "such exploration will not be unduly harmful to aquatic life in the area, result in pollution, create hazardous or unsafe conditions, unreasonably interfere with other uses of the area, or disturb any site, structure or object of historical or archaeological significance" (OCSLA Section 11(g)(3)).

Several grounds exist on which a development and production plan must be disapproved. "If the Secretary determines, because of exceptional geological conditions in the lease areas, exceptional resource values in the marine or coastal environment, or exceptional circumstances, that (1) implementation of the plan would cause serious harm or damage to life (including fish and other aquatic life), to any mineral deposit (in areas leased or not leased), to the national security or defense, or to the marine, coastal or human environments, (2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time, and (3) the advantages of disapproving the plan outweigh the advantages of development and production" (OCSLA Section 25(h) (1) (d)). Furthermore, no plan may be approved unless affected States concur with the plan's certification of consistency with the States' Coastal Zone Management Plan approved by the National Oceanic and Atmospheric Administration. The Secretary of Commerce, may, however, overrule a State objection. For development and production plans, a provision is made for comment by Governors of affected States and executives of affected local governments. At least once in each area, excluding the Gulf of Mexico, the Secretary must declare approval of a development and production plan to be a major Federal action and prepare an environmental impact statement. The regulations giving effect to these provisions of the OCSLA appear at 30 CFR 250.34-1 and 250.34-2. Once exploration or development and production plans are approved, drilling permits from USGS are also required. Permission required by other Federal Agencies is discussed in the next section.

In accordance with Section 21(b) of the OCSLA, all new drilling and production operations, and wherever practicable, existing operations, must use the best available and safest technologies (BAST) which the Secretary determines to be economically feasible. This requirement is applicable to equipment which, if it failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the costs. Section 5(e) of the OCSLA extends the standard

of best available and safest technologies to pipelines. The BAST Program is explained further in a 1980 publication (U.S. Department of the Interior. Geological Survey. 1980a) available from the Office of Deputy Division Chief for Offshore Minerals Regulation, USGS, Mail Stop 640, Reston, VA 22092.

USGS administers the regulations governing mineral operations and development of the OCS under 30 CFR Part 250. These regulations are the basis for OCS operating orders and notices to lessees which apply to operations in the proposed lease area. See Appendix E for operating orders applicable to this proposal. Additionally, USGS maintains jurisdiction over OCS pipelines contained within the boundaries of a single lease, unitized leases, or contiguous leases of the same owner or operator.

BLM cooperates with USGS in reviewing exploration and development and production plans and in enforcing special stipulations that apply to leases within the proposed lease area. These stipulations address such matters as cultural and biological resources, pipeline rights-of-way, and disposition of drilling wastes. In addition to issuing leases, BLM issues rights-of-way for common carrier pipelines on the OCS. BLM also issues permits and designates an authorized officer to manage each permit to protect coral in the vicinity of proposed OCS operations.

The Fish and Wildlife Service (FWS) shares responsibilities with other agencies for protection of fish and wildlife resources and their habitats, and acts in an advisory capacity in the formulation of OCS leasing stipulations. It also provides recommendations to the Corps of Engineers in the issuance of Federal permits to industry for construction in navigable waters. FWS is also responsible for the protection (and stewardship) of species covered under the Endangered Species Act of 1972.

2. Other Federal Agency Responsibilities

Environmental Protection Agency: The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 (86 Stat. 816), created a National Pollutant Discharge Elimination System (NPDES) which applies to discharges into the territorial seas, waters of the contiguous zone, and the oceans. The NPDES applied to fixed platforms and drillships, and any discharges from these sources would require a permit issued by the Environmental Protection Agency (EPA). Discharges of pollutants without the necessary permits from EPA are unlawful. The requirement for obtaining an NPDES permit does not apply to discharge of pollutants from any vessels or floating craft, or subsurface injection wells for production purposes. Subsurface injection is subject to USGS regulations and operating orders.

The Clean Water Act of 1977 (91 Stat. 1566) which amended the FWPCA, also applies to offshore operations and provides that lessees or operators may be held financially liable for damages due to oil spills. It provides for a liability of up to $50 million for actual costs of oil removal and cleanup (except where there is no fault of the operator or owner), as well as replacement or restoration costs of natural resources damaged or destroyed by a spill.

EPA is also primarily responsible for facilities related to transportation, such as terminal and storage facilities, and permits for any discharges would be issued by EPA or designated States according to established effluent guidelines. Provisions of the Clean Water Act also apply to onshore facilities and OCS-related activities.

Control of air emissions under the Clean Air Act applies to all OCS activities, including storage tanks, gas processing facilities, and other onshore OCS-related facilities involving point source emissions. In most cases, permitting authority under this act has been delegated to the States, with oversight responsibility retained by EPA.

Army Corps of Engineers: The OCS Lands Act authorizes the Secretary of the Army to prevent obstruction to navigation in U.S. navigable waters, and to prevent obstructions caused by structures located on the OCS. Section 10 of the Rivers and Harbor Act of 1899 (30 Stat. 1151) requires that permits be issued for all offshore construction, including pipelines, in U.S. navigable waters. Permits must also be issued for onshore facilities in which dredging and filling of U.S. navigable waters are involved. Structure permits for exploratory drilling vessels and for fixed and mobile platforms are issued by the Corps. Permits for structures in State waters must consider environmental requirements before their issuance pursuant to Section 404 of the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977. Section 404 also delegates regulatory authority to the Secretary of the Army for discharge of dredged or fill material in wetlands.

Department of Commerce: The Department of Commerce, through the National Oceanic and Atmospheric Administration (NOAA), is responsible for protection of marine fishery resources and their habitats, for administering the Coastal Zone Management and Coastal Energy Impact Programs, and for providing recommendations to the Corps of Engineers, which issues permits in navigable waters.

The Department's responsibilities and authorities related to OCS activities include those stemming from: the Coastal Zone Management Act of 1972; the Marine Protection, Research, and Sanctuaries Act of 1972, particularly as it relates to Ocean Dumping and Marine Sanctuaries; the Fishery Conservation and Management Act of 1976; the Endangered Species Act of 1973; and the Marine Mammal Protection Act of 1972. Relationships between these programs and proposed Sale No. 52 area are discussed in Section I.D.

Department of Transporation (DOT): The OCS Lands Act grants authority to the Coast Guard to promulgate and enforce regulations covering lighting and warning devices, safety equipment, and other safety-related matters pertaining to life and property on fixed OCS platforms and drilling vessels. Through the Coast Guard, the Department of Transportation advises the Corps of Engineers on the issuance of permits and the placement of offshore structures. Under the Port and Tanker Safety Act of 1978, the Coast Guard has the authority to establish shipping safety fairways and other ship routing systems in which OCS structures may be prohibited (See Section. I.D.8). The Coast Guard also has jurisdiction to enforce the Clean Water Act of 1977 on the OCS.

Under the Federal Water Pollution Control Act, the U.S. Coast Guard approves the procedures to be followed and the equipment used for the transfer of oil from vessel to vessel and between onshore and offshore facilities and vessels. The Coast Guard also conducts pollution and surveillance patrols to detect oil discharges within territorial and contiguous waters and has enforcement authority over violators. The Coast Guard also has strike team responsibilities should an oil spill occur. (See Section I.C.3.).

The Materials Transportation Bureau has the responsibility for establishing and enforcing design, construction, operation, and maintenance regulations for pipelines downstream from the point of production or first processing. The Department of Transportation's responsibility and authority are defined in a Memorandum of Understanding between it and the Department of the Interior.

Department of Energy: In consultation with the Secretary of the Interior, the Department of Energy (DOE) is authorized under the Department of Energy Organization Act, (91 Stat. 565, 1977) to foster increased competition for OCS leases, to implement authorized systems of bidding, to establish due diligence requirements for OCS operations, to set rates of production for lease, to define handling of royalty production, and to determine amounts of OCS gas purchased and transported. DOE has broad authority over approval, design, and economies of common carrier gas pipelines.

In addition, the Department of Energy provides support to the Leasing Liaison Committee, which coordinates leasing policies of the Department of the Interior with DOE policies. Section 27 of the OCS Lands Act, as amended, requires that DOI consult with DOE.

The Federal Energy Regulatory Commission (FERC) within DOE has the authority under the Natural Gas Act to issue certificates of public convenience and necessity for proposed projects involving the transportation or sale of natural gas or interstate commerce. All natural gas produced from the OCS is considered to be interstate and therefore is subject to FERC jurisdiction.

The Natural Gas Act, the National Environmental Policy Act, and the OCS Lands Act, as amended, all grant authority for or require that FERC investigate the environmental effects of a proposed offshore project, as well as the potential gas reserves, the need for the gas, and the availability of capital to develop the resource. Also, FERC is primarily responsible for administering and enforcing the Natural Gas Policy Act (NGPA) of 1978 (92 Stat. 3350). As applied to OCS matters, the NGPA provides new wellhead pricing controls for certain natural gas produced from the OCS.

Interstate Commerce Commission: The Interstate Commerce Commission grants approval of the tariff rates for transportation of oil by common carrier pipelines.

Department of Labor: The OCSLA reiterates the authority of the Secretary of Labor to provide for the protection of occupational safety and health, and describes the jurisdiction applicable to offshore facilities under the National Labor Relations Act.

Attorney General: The OCSLA provides that the Attorney General, in consultation with the Federal Trade Commission, shall comment with respect to preserving competition on the Secretary of the Interior's proposals for regulations or a leasing program, acceptance of bids and issuance of leases, on pipeline permit, and other authority granted by DOE and FERC.

The Attorney General must also comment on the assignment or transfer of leashold interest, may intervene in any court action under the OCSLA, must institute a civil action for enforcement of the OCSLA at the request of an authorized Federal agency, may bring criminal action under the OCSLA, and may bring suit for payment in connection with the Offshore Oil Pollution Compensation Fund.

3. EPA Region I NPDES Permit Responsibilities

Environmental Protection Agency

The Federal Water Pollution Control Act Amendments (FWPCA) of 1972 (86 Stat. 816), created a National Pollutant Discharge Elimination System (NPDES) which applies to discharges into navigable waterways. Fixed platforms and drillships require an NPDES discharge permit issued by the U.S. Environmental Protection Agency (EPA). The requirement for obtaining an NPDES permit does not apply to the discharge of pollutants from vessels or floating craft, or subsurface injection wells for production purposes. Subsurface injection is subject to USGS regulations and Operating Orders. The EPA Region I in Boston has durisdiction for North Atlantic NPDES permits.

Pursuant to Section (403(c) of the Clean Water Act of 1977 (91 Stat. 1566) which amended the FWPCA, Ocean Discharge Criteria (40 CFR 125) were developed in 1980 (FR 45, No. 194, Friday, October 3, 1980). These criteria apply in addition to other effluent guidelines specified under 40 CFR 435 (pursuant to applicable Best Practicable Technology (BPT) - based requirements specified by Sections 301, 304 or 306, and water-quality based limitations specified by Section 303 or 307 of the Clean Water Act) in issuing and revising NPDES Permits and discharges into the territorial seas, waters of the contiguous zone, and the oceans, with the intent of preventing "unreasonable degradation" of the marine environment.

The first NPDES permits for oil and gas operations in the North Atlantic have been issued by the EPA Region I to lessees of Sale No. 42 blocks. These permits are in compliance with the EPA's Ocean Discharge Criteria whereby it has determined that oil and gas exploration in the Georges Bank region would not result in "irreparable harm" to the marine environment. However, the EPA maintains there is insufficient information available to determine whether or

not "unreasonable degradation" would occur from drilling discharges. Consequently, in addition to the standard BPT limitations provided for under 40 C.F.R. 435 the permits incorporate several other provisions:

1. The discharge of certain toxic compounds are prohibited (see Section IV.A.3. Impact Producing Factors Water Pollutants).

2. Special discharge requirements of drilling muds that include: a) a predilution ratio of 10:1; b) a maximum discharge rate of 30 barrels per hour, except where this may prove hazardous to rig operations; c) down-shunting of materials 10 meters below the ocean surface

3. Monitoring requirements that include: a) physical and chemical analysis of drilling muds and cuttings during the drilling operation; b) bioassay and bioaccumulation testing of approved muds on species indigenous to Georges Bank, in order to verify toxicity tests conducted for Mid-Atlantic operations; c) a biological monitoring program, whereby the North Atlantic Biological Task Force Monitoring Program may be used to fulfill the requirement (see Section I.C.4. North Atlantic Biological Task Force).

4. North Atlantic Biological Task Force

On September 21, 1979, the Environmental Protection Agency, and the Department of the Interior (DOI) agreed on a variety of safeguards to increase the protection of the rich biological resources of Georges Bank and their habitats from risk associated with Lease Sale No. 42. These safeguards included a task force composed of one representative each from the Bureau of Land Management (BLM), the Fish and Wildlife Service (FWS), the Geological Survey (GS), the Environmental Protection Agency (EPA), and the National Oceanic and Atmospheric Administration (NOAA). Representative of the affected coastal States participate in activities of the Task Force, but are not formal members. The purpose of the Biological Task Force is to advise the Geological Survey's Oil and Gas Supervisor on those aspects of oil and gas operations resulting from lease Sale No. 42 that affect biological resources on Georges Bank and their habitats.

Under the terms of its charter, the Task Force will: 1) identify and justify areas of special biological significance, 2) recommend the types of surveys which should be conducted, 3) utilize the results of surveys and existing information to predict problems and recommend remedial action. As a member of the Biological Task Force, BLM is currently participating in implementing the design of environmental studies (see Section I.B.1.d) and surveys to provide warning of any adverse impacts due to OCS exploration.

The Biological Task Force, with the consultation of the New England States, established a subcommittee on February 12, 1980 to develop a short-term exploratory-phase study and a long-term monitoring plan to measure the effects of oil and gas exploration on the biological resources of Georges Bank and to develop criteria which could provide warning of any adverse impacts.

In order to determine and identify the fate and effects of discharges associated with oil and gas development on Georges Bank, an understanding is required of: 1) the physical processes operating on Georges Bank which transport materials and nutrients; 2) areas of pollutant accumulation; and 3) the effects of the pollutants on various benthic communities of the Georges Bank ecosystem. Towards this end, a limited field monitoring program, primarily of the benthic community and of the chemistry and geology of the sediments, has been proposed. The program is designed to address: 1) What are the quantities, the physical characteristics, and the chemical composition of materials discharges during OCS drilling operations; 2) Where do discharged materials accumulate - e.g. heads of submarine canyons, the "mud patch", around rigs and in what concentrations; 3) What are the existing background levels of contaminants in the sediments and biota and what levels above background can be detected with existing best available technology? 4) Do benthic change at selected regions on Georges Bank during various stages of OCS oil and gas activity compared with control sites; can these changes be related to observed changes in pollutant levels associated with discharges; and, what are the concentration of pollutants associated with these changes?

The major emphasis of the monitoring program is to link the fate of discharges from oil and gas exploratory operations to effects on benthic components. Additional studies are to be conducted in the areas of data management, geochemistry, and analysis of relevant historical data.

The benthic sampling program will be conducted on a seasonal basis, beginning in the summer of 1981. Thirteen "regional stations" will monitor broad-scale, long-term changes in benthic epifauna and infaunal populations, sediment texture, and the chemistry of sediments and benthic organisms, resulting from oil and gas operations. In addition to the long-term regional stations, a site-specific array of twenty-nine stations will be located around an exploratory rig. These stations will determine local changes in the sediment texture, sediment chemistry and the benthos in the immediate vicinity of drilling activity. All monitoring stations - both long term regional and site-specific - shall take samples before and after drilling, on a seasonal basis until any pollutants or changes in the benthic community observed during post-drilling sampling have reached pre-drilling levels.

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